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Volume 16 Number 14

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July 31, 1962

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Volume 16, Number 14 July 31, 1962

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

17338 (NP-11439) LITERATURHINWEISE ZU RECHTS- UND WIRTSHAFTSFRAGEN DER ATOMENERGIE. (Literature References on Legal and Economic Questions of Atomic Energy). (Kernforschungsanlage, Jülich, Germany). Jan. 2, 1962. 69p.

The bibliography is divided into groups of items appearing in a reference library and those published as papers. (About 375 references) (J.R.D.)

17339 (NP-11504) LIST OF PUBLICATIONS AVAILABLE TO THE PUBLIC. Cumulation No. 6, January–December, 1961. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 112p.

A listing of 1300 unclassified reports, translations, periodical articles, and books announced during 1961, together with patent applications filed by the UKAEA is given. The references are listed under the following subject headings: general; biology, medicine, and agriculture; general chemistry; radiochemistry; analytical chemistry; chemical engineering; engineering; instrumentation; geology and mineralogy; health and safety; industrial applications of isotopes and radiations; isotope separation; mathematics and computers; metallurgy and materials; radiation effects on materials; general and solid state physics; nuclear and theoretical physics; plasma physics and controlled thermonuclear devices; particle accelerators; reactor physics; reactor technology; waste disposal; patents; and reports which have appeared in the published literature. Author and report number indexes are included. (M.C.G.)

17340 (NP-11506) SURFACE BURST OF 100 TON TNT HEMISPHERICAL CHARGE (1961). Suffield Report No. 205. W. R. Smale and R. C. Sigs, comps. (Canada. Suffield Experimental Station, Ralston, Alberta). Jan. 1962. 86p.

A 100 ton TNT explosion is described. Other activities in a program to measure blast effects from a series of explosions increasing from a few pounds through 100 tons of TNT are also discussed. An over-all picture of the projects involved is provided and data which would be of immediate use to participating agencies are given. (auth)

17341 (PNE-104P) CLOSE-IN SHOCK STUDIES, PRELIMINARY REPORT. David B. Lombard and Dean V. Power (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 22, 1962. Project GNOME. Contract [W-7405-eng-48]. 23p.

Measurements of shock parameters, including particle velocity profile and peak shock pressure, were attempted in the salt close-in to the Gnome nuclear explosion. The measurements were to be compared with results predicted by the UNEC code. Radiation-fogged film and damaged instruments nullified most of the measurements. (auth)

17342 (PNE-128P) SUMMARY OF PREDICTIONS AND COMPARISON WITH OBSERVED EFFECTS OF GNOME ON PUBLIC SAFETY. Preliminary Report. (Beers (Roland F.), Inc., Alexandria, Va.). Feb. 15, 1962. Contract [AT(29-2)-1163]. 11p. Project GNOME.

Predictions of the effects of Project Gnome are compared with results. It is shown that the predicted values are not unreasonably removed from the observed values. There is a difference in agreement between vertically propagated energy and horizontally propagated energy. The reasons for this difference, which is an order of magnitude, are discussed. (M.C.G.)

17343 (AEC-tr-4144) SELECTED ARTICLES FROM NUKLEONIKA. Translation of Nukleonika, 3: No. 1, 3-13; 15-25; 27-40; 43-82; 111-32(1958). 74p.

Eleven selected articles from Nukleonika, Vol. III, No. 1 were translated from Polish. Topics covered are nuclear power problems in Poland, processing Polish uranium-bearing raw materials, Poland's first nuclear reactor, reaction mechanisms of hot atoms, chemical properties of plutonium in aqueous solutions, semi-automatic registration and analysis of gap lengths in tracks in nuclear emulsions, proportional 2-flow counter, G-M flow counter, neutron counters with boron trifluoride, and proportional cylindrical flow counter. (M.C.G.)

17344 (AEC-tr-4145) SELECTED ARTICLES FROM NUKLEONIKA. Translation of Nukleonika, 3: No. 2, 166-79; 184-99; 216-44(1958). 54p.

Seven selected articles from Nukleonika, Vol. 3, No. 2 were translated from Polish. Topics covered include: "two-and-a-half" group equations and their application to uranium–water systems, the second Polish Research Reactor, non-conservation of parity in beta decay, radioisotope problems at XVIth International Congress of Pure and Applied Chemistry, course and cause of reactor damage at Windscale, and a new type of accelerator. (M.C.G.)

17345 (AEC-tr-4146) SELECTED ARTICLES FROM NUKLEONIKA. Translation of Nukleonika, 3: No. 3, 255-97; 299-341; 357-9(1959). 69p.

Eight selected articles from Nukleonika, Vol. 3, No. 3 were translated from Polish. The topics covered include: radiation effects on semiconductors, pile graphite, organic compounds as moderators and coolants, pulse rise time in BF_3 proportional counters, structure and mechanisms of

chemical protective agents against ionizing radiation, distribution of radioisotopes, and biological isotope centers in Czechoslovakia. (M.C.G.)

17346 (AEC-tr-4147) SELECTED ARTICLES FROM NUKLEONIKA. Translation of Nukleonika, 3: No. 4, 369-427; 471-4(1958). 51p.

Six selected articles from Nukleonika, Vol. 3, No. 4 were translated from Polish. Topics covered include: polonium, study of wear of machine parts with radioisotopes, scalers based on the Eccles-Jordan type trigger circuit, radiological protection abroad and in Poland, G-M counter platograph, and the Scientific Conference in Dubna. (M.C.G.)

17347 (AEC-tr-4150) NUKLEONIKA. Translation of Nukleonika, 4: No. 1, 1-32; 35-45; 47-85; 87-100; 103-11 (1959). 88p.

Twenty-two selected articles from Nukleonika, Vol. 4, No. 1 were translated from Polish. Topics covered include: isotope effect in the Van Slyke combustion of some C^{14}-labeled aliphatic alcohols and acids, separation of isotopes in ultracentrifuges, use of radiation in sterilization of food and medical supplies, survey of principle radioisotopes in biology and medicine, nuclear research in Brazil, extraction properties of TBP ester, 14-channel amplitude analyzer, electronic scalers and counters, external-moderator reactor, experimental reactor with high neutron flux, experimental fluidized plutonium reactor, natural uranium reactor with heavy water moderator and biphenyl coolant, fluidized salts power reactor, stannous fluoride a fuel carrier, damage to graphite during irradiation to 1000°C, effects of carbon dioxide on graphite in reactor conditions, and reactor siting criteria. (M.C.G.)

17348 (AEC-tr-4151) NUKLEONIKA. Translation of Nukleonika, 4: No. 2, 119-236(1959). 93p.

Eleven selected articles from Nukleonika, Vol. 4, No. 2 were translated from Polish. Topics covered include: neutron–phonon interaction in solids, uranium technology, chemical subjects at Second International Atoms-for-Peace Conference, nuclear power development, biological and medical subjects at Second International Atoms-for-Peace Conference, personnel training, fall-out studies at Hornsund Fiord in Spitzbergen, boron trifluoride counters, and pulse time distribution analyzer operating with mechanical neutron selector. (M.C.G.)

17349 (AEC-tr-5025) NOMOGRAM FOR CALCULATING ATTENUATION OF AIR SHOCK WAVES IN TUNNELS. Siwert Eriksson (Sweden. Kungliga Fortifikationsförvaltningen, Stockholm). Translated from Report No. 103: 24. Apr. 14, 1961. 17p.

A method is presented for calculating shock wave pressure in tubes if the frontal pressure and the impulse density are known. The method is presented in a compact nomogram form. Results of tests with relatively small tubes are also extrapolated to include areas of the order of magnitude of tunnels. (J.R.D.)

17350 (AEC-tr-5026) EFFECT OF CONTACT DETONATION ON GRANITE SLABS. (Sprängämnes Verkan vid Kontaktdetonation mot Granitplattor). K. B. Broberg (Sweden. Kungliga Fortifikationsförvaltningen, Stockholm). Translated from Report No. 109:15. Aug. 1960. 52p.

Theories and experiments on explosive cratering, shock waves, and scabbing on rock surfaces are discussed. Analytical results indicate that rock movements caused by contact-detonated nuclear weapons are considerably greater than previously thought. (J.R.D.)

17351 (AEC-tr-5029) REPORT ON THE FRENCH NUCLEAR PROGRAM. (European Atomic Energy Society, Paris). Translated from a paper presented at the Enlarged Symposium on Principles, Implementation and Trends of National Nuclear Programs held in Lisbon, October 16-20, 1960. 5p.

Included is information on objectives and scope of the nuclear program, general organization, plants, present and future projects, annual power consumption, and economic factors related to the research effort. (J.R.D.)

17352 (AEC-tr-5030) REPORT ON THE BELGIAN NUCLEAR PROGRAM. (European Atomic Energy Society, Paris). Translated from a paper presented at the Enlarged Symposium on Principles, Implementation and Trends of National Nuclear Programs held in Lisbon, October 16-20, 1960. 8p.

Information is presented on the Mol Center activities concerning reactor fuel research, Belgian reactors, radioisotope production, radiobiology, power production, and research financing. (J.R.D.)

17353 LEGAL ASPECTS OF THE PEACEFUL UTILIZATION OF ATOMIC ENERGY. Hans Kruse. Berlin. Verlag Neue Wirtschafts-Briefe, 1960. 111p.

National legislation in the field of atomic energy is reviewed. Emphasis is placed on legislation in the United States, Canada, Great Britain, France, Sweden, and the Federal Republic of Germany. No authentic information was available with regard to the Soviet Union. (C.H.)

17354 THE ISOTOPE INDEX. COMPLETE GUIDE TO THE ISOTOPES. Volume VI. J. L. Sommerville, ed. Indianapolis, Scientific Equipment Co., 1962. 208p. $4.00.

The index contains information on stable and radioactive isotopes, isotope suppliers, AEC licensing procedures, general license quantities, and isotope compounds. Tables are presented of beta and gamma energies and half lives. A generalized decay curve is also presented. (N.W.R.)

17355 SEISMIC EFFECTS OF UNDERGROUND EXPLOSIONS. Authorized Translation from the Russian. New York, Consultants Bureau, 1962. 91p. $22.50. Translated from Trudy Inst. Fiz. Zemli im. O. Yu. Shmidta, Akad. Nauk S.S.S.R., No. 15, 3-108(1960). (NP-tr-871)

Four papers are included for each of which a separate abstract was prepared. (J.R.D.)

17356 RESULTS OF SEISMIC OBSERVATIONS ON UNDERGROUND NUCLEAR AND TNT EXPLOSIONS. I. P. Pasechnik, S. D. Kogan, D. D. Sultanov, and V. I. Tsibul'skii. p.1-42 of "Seismic Effects of Underground Explosions." New York, Consultants Bureau, 1962. Translated from Trudy Inst. Fiz. Zemli im. O. Yu. Shmidta, Akad. Nauk S.S.S.R., No. 15, 3-52(1960).

A description is presented of seismic data obtained in the U. S. and U.S.S.R. from underground nuclear explosions in Nevada in 1957-1958. Data are given on seismic wave transit times, on longitudinal wave relations with the epicentral distance, and on the shot magnitudes. Data are also included on the seismic effects of Soviet underground TNT explosions. (J.R.D.)

17357 SEISMIC MAGNITUDES OF UNDERGROUND NUCLEAR EXPLOSIONS. Yu. V. Riznichenko. p.43-69 of "Seismic Effects of Underground Explosions." New York, Consultants Bureau, 1962. Translated from Trudy Inst. Fiz. Zemli im. O. Yu. Shmidta, Akad. Nauk S.S.S.R., No. 15, 53-87(1960).

An analysis of results is presented on determining the magnitudes of nuclear explosions set off underground in Nevada in 1957-58. The data are correlated with the annual number of earthquakes throughout the world exceeding in

magnitude the underground explosions of any specified yield. (J.R.D.)

17358 DIFFERENCES IN THE SPECTRA OF SURFACE WAVES FROM EARTHQUAKES AND FROM EXPLOSIONS. V. I. Keilis-Borok. p.71-82 of "Seismic Effects of Underground Explosions." New York, Consultants Bureau, 1962. Translated from Trudy Inst. Fiz. Zemli im. O. Yu. Shmidta, Akad. Nauk S.S.S.R., No. 15, 88-101(1960).

The relations between spectra of surface waves in layered media and the dimensions and form of the source are examined. The predominant period of surface waves from underground explosions is found to be about one-fourth the period typical of surface waves from earthquakes of approximately the same intensity and epicentral distance. (J.R.D.)

17359 THEORETICAL MODEL OF AN EXPLOSION AT AN INTERFACE. T. I. Vavilova and B. Ya. Gel'chinskii. p.83-8 of "Seismic Effects of Underground Explosions." New York, Consultants Bureau, 1962. Translated from Trudy Inst. Fiz. Zemli im. O. Yu. Shmidta, Akad. Nauk S.S.S.R., No. 15, 102-8(1960).

A theoretical model for the behavior of an expansion center in the vicinity of an interface is presented. It is shown that the first arrival of the longitudinal wave is directed away from the source (compressional wave), as in a homogeneous medium. (J.R.D.)

BIOLOGY AND MEDICINE

General and Miscellaneous

17360 (HW-SA-2544) AUTORADIOGRAPHY OF TISSUE. N. L. Dockum (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Apr. 20, 1962]. Contract AT(45-1)-1350. 34p.

Techniques used for autoradiography of human and animal tissues and, to a limited extent, plant tissues are discussed. Plutonium is used as an example to illustrate an alpha-autoradiographic technique by which either particulate or soluble material may be graphically localized. Suggested autoradiographic techniques for the beta emitters I^{131}, Ru^{106}, Sr^{90}, and P^{32} are described. The use of Zn^{65} in autoradiography is discussed. (M.C.G.)

17361 (TID-14387) ENERGETICS TRANSFER IN THE PHOTODYNAMIC REACTION. First Annual Progress Report, November 1961. Leonida Santamaria (Milan. Universita. Istituto di Patologia Vegetale). Contract AT(30-1)-2734. 75p.

Discussions are presented of investigations of: the photodynamic action of polycyclic hydrocarbons on isolated mitochondria in relation to their carcinogenicity; the photodynamic activities of 3,4-benzopyrene, crysene, and 10-methyl-1,2-benzanthracene and its mono-fluoro- derivatives in human blood serums; and evidence of natural photodynamic processes in calf retina. In the interpretation of the photodynamic action, analyses were made for the effects of a photosensitizer, the dependence on oxygen, and the oxidation of a substrate. A ground plot of a theory on the mechanism of photodynamic action and its possible application to experimental research was developed on the basis of an application of Jehle's theory on the specificity of London interactions. (B.O.G.)

17362 (UCRL-Trans-778) THE DEVELOPMENT OF PRIMARY POLYCYTHEMIA TREATED BY RADIOACTIVE PHOSPHORUS. A STUDY OF A SERIES OF 310 CASES. M. Tubiana, G. Vallée, M. Boiron, and R. Pérez. Translated by Raphaella Kingsbury and Thomas Knatt (Univ. of California Lawrence Radiation Lab., Berkeley) from Nouvelle rev. franç. hématol., 1: 445-9(1961). 33p.

A study was made of a series of 310 cases of polycythemia treated with radioactive phosphorus. An initial dose of 1 mc P^{32} per 10 kg of body weight was sufficient in more than 92% of the cases to provoke a hematological and clinical diminution. The number of cases in which the average annual dose was greater than 1 mc increased significantly with the size of the spleen. This proportion was also slightly higher when the number of white blood cells was greater than 20,000. Twenty-two cases of malignant hemopathy were observed. The proportion of hematological complications appeared to be higher in cases where the spleen was greatly enlarged, the number of white blood cells greater than 15,000, and the average annual dose increased. (M.C.G.)

17363 DEMONSTRATION OF A NON-RNA NUCLEOLAR FRACTION BY SILVER STAINING. N. K. Das (Univ. of California, Berkeley). Exptl. Cell Research, 26: 428-31(Mar. 1962).

Modifications are described of a technique for the silver staining of the nucleoli of plant and animal cells. The technique makes it possible to detect the sequences in the formation of nucleoli in cells. Autoradiographic studies of the same cells show that tritiated thymidine incorporation into micronuclei is correlated with the presence of silver stainable nucleolar material. Applications of the technique for the study of nucleolar formation and function in a variety of plant and animal cells are described. A non-RNA nucleolar fraction was demonstrated by this technique. (C.H.)

17364 STUDIES ON PHOTOREACTIVATION IN GAMETES AND ZYGOTES OF THE SAND DOLLAR, ECHINARACHNIUS PARMA. John S. Cook and Alvin F. Rieck (New York Univ. School of Medicine, New York; Marquette Univ. School of Medicine, Milwaukee; and Mount Desert Island Biological Lab., Salsbury Cove, Me.). J. Cellular Comp. Physiol., 59: 77-84(Feb. 1962).

Cleavage in the zygote of E. parma is delayed by uv irradiation of either the egg or sperm. Illumination in the spectral range 0.3 to 0.5 μ will mitigate cleavage delay if applied to fertilized or unfertilized eggs which have been irradiated, or if applied to eggs which have been fertilized with irradiated sperm. Illumination of irradiated sperm prior to fertilization exacerbates the ultraviolet effect. Cleavage delay after sperm irradiation is independent of the dose-rate. No evidence was found for thermal reactions associated with the production of the uv lesion. Maximal photoreactivation of the cleavage delay in irradiated eggs shows a dose-reduction factor of about 0.25. Photoreactivation in irradiated eggs shows a refractory period during which illumination can no longer mitigate the delay in first cleavage. Illumination during this period is effective in mitigating the prolonged first-to-second cleavage interval. (auth)

17365 ON THE INCIDENCE OF LEUKEMIAS IN HIROSHIMA DURING THE PAST FIFTEEN YEARS FROM 1946 TO 1960. Susumu Watanabe (Hiroshima Univ.). J. Radiation Research (Japan), 2: No. 2, 131-40(Sept. 1961). (A/AC.82/G/L.732). (In English)

Addition to A/AC.82/G/L.400.

The incidence of leukemias in Hiroshima from 1946 to 1960 is discussed. In 1960, the total number of leukemias in Hiroshima was 14 for an incidence of 3.25 per 100,000. In the same year, 4 cases were reported among those people expresed to the atomic bomb for an incidence of 4.18 per 100,000. These figures and also the death rates are lower than in previous years. Exposure to radiation appeared to be significant in giving rise to chronic myeloid leukemia to a greater degree than other types of leukemia. The incidence of leukemia to those exposed to the atomic bomb within 5000 m began to rise in 1947 and kept its high level during the 1948 to 1959 period to form a plateau ranging from a maximum incidence of 174 to a minimum of 92. In 1960 the incidence appeared to decline rather sharply. (M.C.G.)

17366 CHROMOSOMES OF TWO CASES OF HUMAN CHRONIC MYELOID LEUKAEMIA. P. H. Fitzgerald (Wakari Hospital, Dunedin, N. Z.). Nature, 194: 393 (Apr. 28, 1962).

The presence of an abnormally small chromosome (Ph^1) replacing one of the smallest acrocentric autosomes is looked for in blood cells of two patients with chronic myeloid leukemia. The Ph^1 is observed in about half the cells of one of the patients, who has received no treatment for the disease. No Ph^1 is found in the cells of the other pa-

tient, who has a long history of diagnostic irradiations (about 180 r) and an unusually slow progression of the disease. The role of the Ph[1] chromosome in the neoplastic process is discussed. (T.F.H.)

17367 INTERFERENCE BY TUNGSTEN WITH UPTAKE OF MOLYBDENUM BY PLANTS. H. J. M. Bowen and P. A. Cawse (Wantage Research Lab., Berks, Eng.). Nature, 194: 399-400(Apr. 28, 1962).

The uptake by tomato plants of a nutrient solution containing a W-1 to 100 mole % Mo mixture is studied. Increasing W content depresses the total uptake. Further, the Mo concentration at every level tested is higher in the nutrient solution than in the plant or seed, indicating that W is discriminated against in favor of Mo. It is concluded that W is not necessary for the growth of the tomato plant, but may replace Mo if Mo is not available. (T.F.H.)

17368 CURATIVE EFFECT OF HOMOLOGOUS BONE MARROW TRANSFUSIONS IN RATS RECEIVING LETHAL DOSES OF 'MYLERAN.' A. Dunjic (Univ. of Louvain, Belg.). Nature, 194: 493-5(May 5, 1962).

Bone marrow suspensions, containing 128×10^6 nucleated bone marrow cells, were injected in inbred rats on the first or third day following oral administration of 20.7 to 41.4 mg/kg tetramethylene methanesulfonic acid (Myleran). The homologous bone marrow transfusions given on the first day following administration of Myleran decreased the 30 day mortality rate to values of between 80 and 63.6%. When bone marrow transfusions were given on the third day, the decrease of mortality was more important and the mortality rates varied from 60 to 44.4%. The mortality rates seem to be independent of Myleran dosage for both the injection days and the dose range of Myleran used. The results are compared with experiments on randomly bred rats. It is concluded that under some experimental conditions, the homologous bone marrow treatment may be obtained following the administration of radiomimetic chemicals, and that the requirements for successful homologous bone marrow transplantation are similar to those met in bone marrow experiments with irradiated mammals. (P.C.H.)

17369 ALTERATION OF SPORULATION IN ASPERGILLUS NIGER BY HEAT AND DEUTERIUM OXIDE. Thomas R. Henderson and James S. Dinning (Univ. of Arkansas, Little Rock). Nature, 194: 498-9(May 5, 1962).

Investigations were made on the effect of heating Aspergillus niger spores in a 99.5% deuterium oxide medium as well as heating in a water medium and in the dry state. Results show that spores suspended in deuterium oxide are considerably more resistant to heat inactivation than spores suspended in water. However, the most notable variation observed in heated spores involved the subsequent capacity for sporulation such as inability of aerial hyphae to differentiate into conidiophores, changes in the appearance and pigmentation of conidiophores with only minimum sporulation allowed, or delayed sporulation. The elicitation of non-sporulating strains by heating was confined almost exclusively to spores suspended in deuterium oxide. The most probable explanation of the synergistic effect of deuterium oxide and heat in producing sporulation anomalies is an alteration of the hydrogen bonded secondary structure of DNA. (P.C.H.)

17370 MUSCLE EQUIVALENT MATERIAL. K. Kawashima, Y. Takaku, T. Inada, and H. Matsuzawa (National Inst. of Radiological Science, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2460-2(1961).

A tissue-equivalent material was constructed from the following components: polyethylene $(CH_2)_n$, 71.4% (by weight), $NaNO_3$ 21.3%, Al_2O_3 5.5%, and TiO_2 1.8%. The attenuation coefficients of this solid compound, Mix. p in x or γ rays (40 kev – 1.25 Mev), were shown to be equal to those of a section of pork loin (m. longissimus dorsi). Thus, Mix. p is concluded to be good phantom material for depth dose measurement and suitable material for walls of ionization chambers. (Abstr. Japan Med., 2: No. 3, March 1962)

17371 ROLE OF FREE RADICALS IN MUTATION, CANCER, AGING, AND THE MAINTENANCE OF LIFE. Denham Harman (Univ. of Nebraska Coll. of Medicine, Omaha). Radiation Research, 16: 753-63(May 1962).

Mutation, cancer, and aging are attributed basically to the side effects of endogenously formed free radicals. Evidence is presented for the formation of these radicals along with considerations of how they might produce their effects as well as possible differences in the mode of action of endogenous and radiation-induced radicals. Experimental work on the aging process based on the above hypothesis has been encouraging: Several antioxidants were found to increase the half-survival time of AKR and C3H mice; the prolongation with 2-mercaptoethylamine was around 20%. Serum mercaptan levels, as predicted by the free radical hypothesis, were found to decrease with age. This free radical hypothesis raises the possibility that the continued survival of living things in a changing environment is fundamentally a result of the selection by them of reactions that not only serve as major sources of energy but also, through the intermediate formation of active free radicals, provide, on the one hand, for mutation—and hence of evolution and survival—and, on the other, and by essentially the same mechanism, for cancer and aging. The latter two phenomena can be considered to play a useful role, and possibly a necessary one, in the evolutionary process by aiding in the disposal of old organisms after they have provided new experiments for evaluation against the environment. (auth)

17372 PARABIOTIC INTOXICATION. I. BLOOD VOLUME, TOTAL CIRCULATING RED CELL MASS, AND Fe^{59} UPTAKE. Margaret H. MacGillivray and S. Tokuda (California Inst. of Tech., Pasadena). Transplantation Bull., 29: 83-90(Apr. 1962).

The hybrid's anemia in parent-F_1 parabiotic intoxication in mice is accompanied by a reduction in blood volume and total circulating red cell mass. The parental polycythemia constantly exhibits an increased total circulating red cell mass. Blood volumes are elevated in the 9th and 11th days of parabiosis but not on the 4th. Histologic, hematologic, and Fe^{59} uptake studies indicate increased erythropoiesis in both parabionts. Alterations in the total red cell mass compartments are compatible with the hypothesis of a massive shift of blood between the parabionts. It is suggested that this shift is brought about by unequal cross-transfusion resulting from occlusion of the vascular channels returning blood to the hybrid. Mechanically trapped sensitized RBC or the occlusive action of immunologically competent parental cells are two possible immune mechanisms leading to the hematocrit alterations. (auth)

17373 PARABIOTIC INTOXICATION. II. THE DISTRIBUTION AND SURVIVAL OF Cr^{51}-LABELED RED BLOOD CELLS. S. Tokuda and Margaret H. MacGillivray (California Inst. of Tech., Pasadena). Transplantation Bull., 29: 90-5(Apr. 1962).

The anemia and polycythemia in parent-to-F_1 parabiotic intoxication in mice were studied using Cr^{51}- and Fe^{59}-

labeled red blood cells. It was observed that the anemia and polycythemia result from a shift in red cell mass from the hybrid into its parent strain partner. Because cross-circulation was observed between the parabionts during the anemia and polycythemia, the shift is attributed to unequal cross transfusion between the parabionts. There was neither preferential selection nor preferential destruction of either parental or hybrid red cells during the shift in red cell mass. (auth)

17374 STUDIES OF SMALL-MAMMAL POPULATIONS ON THE RADIOACTIVE WHITE OAK LAKE BED. Paul B. Dunaway and Stephen V. Kaye (Oak Ridge National Lab., Tenn.). p.167-85 of "Transactions of the Twenty-Sixth North American Wildlife and Natural Resources Conference, March 6, 7, and 8, 1962." Washington, D. C., Wildlife Management Institute, [1961].

Populations of small mammals were studied on the radioactive White Oak Lake bed after the lake was drained. The lake served for 12 years as a holdup basin for radioactive wastes until it was drained in 1955. Small-mammal populations were also studied on an uncontaminated old field. More species and a greater total number of small mammals were present in later successional stages on the lake bed than in earlier stages. The cotton rat was the dominant small-mammal species on the lake-bed area from the summer of 1957 to the winter of 1959-60. The populations of cotton rats were exterminated on the lake-bed and old-field areas during the severe winter of 1959-60. This species is used as an example for further discussion of population dynamics. Greatest trapping success at the lake bed was in the summers. The number of animals caught on the lake bed in spring was only slightly less than in fall because of immigration during winter and early spring. The average greatest distance between points of capture was 573 ± 216 ft for males and 236 ± 54 ft for females in the months from May through October (1957–1959). The average greatest distance from November through April was 276 ± 96 ft for the males and 175 ± 65 ft for the females. Only 28 out of 248 rats were captured for over six months at the lake bed and only one was trapped for over a year. About 35 percent of the 248 rats were apparently transients. Significantly more males than females were caught on the lake bed (178 males to 137 females; $\chi^2 = 5.336$, $P = 0.025$). More females than males were trapped from late spring or summer to late fall or early winter, while more males were captured during the remaining time. The reproductive season occurred mainly from about April to October. Strontium-90 was the most abundant radioisotope in the tissues and was the only radioisotope present in greater concentrations in the tissues (625 μμc/g, dry wt) than in the food (132 μμ/g, dry wt). Effects of atomic radiation were not detected in this study. (auth)

17375 TRITIUM IN THE PHYSICAL AND BIOLOGICAL SCIENCES. VOL. II. Proceedings of the Symposium on the Detection and Use of Tritium in the Physical and Biological Sciences, held in Vienna, 3-10 May 1961. (International Atomic Energy Agency, Vienna). Proceedings Series. Feb. 1962. 451p. (STI/PUB/39(Vol.II)). $8.00(IAEA).

A total of 38 papers is presented on the biological applications of tritium and tritiated compounds. They treat synthesis of tritiated organic and biological compounds, radiation effects of tritium, metabolism studies, use of tritiated thymidine and related compounds for studies of cell metabolism and in radiobiology. Separate abstracts were prepared for 33 of the papers, while the remaining 5 were previously abstracted in NSA. (D.L.C.)

17376 GAS EXPOSURE METHOD FOR TRITIUM LABELLING. K. E. Wilzbach (Argonne National Lab., Ill.). p.3-10 of "Tritium in the Physical and Biological Sciences. Vol.II." Vienna, International Atomic Energy Agency, 1962. (In English)

Labeling of organic compounds by exposure to tritium gas is reviewed, with emphasis on aspects of practical importance. Consideration is given to such points as: experimental techniques, types of compounds labeled, levels of activity obtained, distribution of tritium introduced, and the nature of tritiated by-products. It is expected that the information presented will help to define the area of usefulness of the technique, aid in the selection of purification procedures, and provide some basis for predicting results in a given case. (auth)

17377 SPECIFIC TRITIUM LABELLING OF ORGANIC COMPOUNDS BY THE GAS EXPOSURE METHOD. P. Y. Feng and T. W. Greenlee (Armour Research Foundation, Chicago). p.11-20 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A method is described for preparing, conveniently, extremely high specific activity tritiated organic compounds in which the tritium atoms occupy specific, predetermined locations in the molecular structure. This method consists of a modification of the gas phase tritium labeling method by allowing tritium to react preferentially with a specific portion of a molecule. It takes effective advantage of the pronounced radiation sensitivity of certain chemical bonds (e.g. C-I bonds). Thus, when selected iodine compounds are exposed to tritium gas, preferential replacement of iodine by tritium occurs, resulting in specific tritiation. As an illustration, the results for the preparation of para-tritiated benzoic acid are cited. This was prepared by the tritiation of p-iodobenzoic acid. Specificity was proved by converting the product successively into benzamide (I), acetanilide (II), 2,4,6-tribromoaniline (III), and p-bromoacetanilide (IV) and determining the specific tritium activities at these various stages. The results show that at least 9ℓ% of the tritium activity in (I) and (II) were removed when the hydrogen at the paraposition was removed by bromination ((III) and (IV)), indicating the specificity of this technique as compared to the almost random labeling by the conventional gas tritium exposure method. (auth)

17378 STUDY ON THE POSITION OF TRITIUM IN AROMATIC MOLECULES LABELLED BY DIFFERENT METHODS. H. J. Ache, W. Herr, and A. Thiemann (Universität, Cologne; Max-Planck-Institut für Chemie, Mainz; and Kernforschungsanlage, Jülich, Ger.). p.21-36 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A developed high-temperature radio-gas chromatography permitted fast and reliable analysis of toluene derivatives for the purpose of obtaining information on tritium distribution in the toluene molecule. The comparison of the various methods of H^3-labeling showed the specific influence of the energy pick-up. The results were also compared with those in the nitro- and chloro-benzene system. The gas exposure technique, electric discharge, irradiation by u-v light, high energetic recoils, and microwaves were applied in this investigation. Whereas in the case of toluene the gas exposure techniques favor the substitution in the ring, the electric discharge and microwave treatment leads to preference of the methyl group. The G_T-value (number of H^3 atoms incorporated in toluene per 100 ev absorbed) was found to be nearly independent from the H^3- or toluene pressure but to increase with growing amounts of tritium. (auth)

17379 SPECIFIC ACTIVITY OF CHARCOAL-ADSORBED COMPOUNDS AFTER H^3-LABELLING BY THE WILZBACH PROCEDURE. M. Wenzel, H. Wollenberg, and P. E. Schulze (Freie Universität, Berlin and Schering A. G., Berlin). p.37-46 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The use of H^3-labeled compounds for tracers has the advantage of a lower health risk than the use of other radioactive isotopes. On the other hand, because of its low energy the tritium beta-particle is difficult to count. In biochemical research, especially for radioautography, the H^3-labeled compounds must have a high specific activity if they are to be traced exactly in high dilution. In the Wilzbach procedure, the H^3-labeled compounds have a specific activity which corresponds, among other factors, to the surface of the compound. To obtain a very high surface, the compounds were adsorbed on charcoal before H^3 gas exposure. The results of the experiments with a new simple tritiation apparatus showed an increase of the specific activity of the adsorbed compounds up to more than 100 times compared with with the specific activity of identically handled normal control charges. Furthermore, an inverse correspondence of the concentration of the H^3-exposed compounds on the charcoal to the specific activity after labeling was found. No signs for an increase of radioactive impurities by this modification were found. (auth)

17380 THE SYNTHESIS OF TRITIUM-LABELLED AROMATIC COMPOUNDS BY PLATINUM-CATALYZED EXCHANGE WITH TRITIUM OXIDE. J. L. Garnett, L. Henderson, and W. A. Sollich (Univ. of New South Wales, Sydney). p.47-59 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The platinum-catalyzed exchange between tritiated water and aromatic hydrocarbons and their derivatives was investigated at 130 to 180°C. Differences in tritiation rate were observed for the fifty compounds studied, but, in general, there is a close agreement between rate-of-exchange and ionization potential data for a particular series of compounds. For, example, naphthalene derivatives exchange more slowly than the corresponding members of the benzene series while in the monohalogenated benzenes and naphthalenes, rate-of-exchange decreases with increasing size of halogen substituent. From the trend in this data, it can be postulated that chemisorption of aromatic systems on active platinum occurs through π-complex formation. Interesting orientation effects were also observed during these exchange reactions. The ortho position of benzoic acid exchanges much faster than do the meta and para positions, while in the monohalogenated benzenes the reverse holds and hydrogen in the ortho position exchanges more slowly than in the meta or para positions which react at approximately the same speed. Ortho exchange increases with increasing size of halogen substituent and it would appear that deactivation of the ortho position occurs when the inductive effect acts out of the ring while ortho activation occurs when the effect acts in the reverse direction. As a synthetic method, especially for aromatics, this catalytic exchange procedure is attractive since radiochemical by-product formation is minimized when the technique is compared with the conventional recoil tritiation and the Wilzbach gas irradiation procedures. For aliphatic systems rate of catalytic exchange is very much slower than with aromatics and thus at present with aliphatic compounds the alternative labeling techniques are to be preferred. (auth)

17381 TRITIUM LABELLING BY MEANS OF URANIUM HYDRIDE. R. E. Felter and L. A. Currie (Pennsylvania State Univ., University Park). p.61-8 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A new and efficient method for introducing tritium into organic molecules was observed. Labeling is accomplished by exposure of the organic vapor to heated uranium tritide. In experiments with n-pentane and with ethylene, the principal labeled products were the tritiated parent molecules. The rates of tritium incorporation varied from about 0.2 to 10.0% (of initial tritium) per hour. The mechanism of the reaction was demonstrated to be not a result of radiation chemistry, but rather a direct reaction of hydrogen atoms from the surface with the hydrocarbon. In addition to the rapid labeling with a significant fraction of the tritium present, the method has another unique advantage: tritium which has not reacted with the organic vapor may be removed from the gas phase simply by cooling the reaction vessel to room temperature. (auth)

17382 TRITIUM EXCHANGE IN BIOLOGICAL SYSTEMS. W. Siri and J. Evans (Univ. of California, Berkeley). p.71-84 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Whenever tritium-labeled water is employed as a test solute or tracer in biological systems, an appreciable exchange between tritium and labile hydrogen atoms occurs that frequently affects the nature and interpretation of experimental results. The studies reported are concerned with the magnitude of the effect that tritium exchange introduces into measurements of total body water and water metabolism in animals and humans. Direct measurements of exchange were made in rats, guinea pigs, pigeons, and rabbits. Tritium-labeled water was administered intravenously or by mouth, and tritium space and turnover determined from the concentration of tritium in blood. The animals were then desiccated to constant weight in vacuo. The specific activity of water collected periodically during desiccation increased by 50% as a result of isotope effects. Water from combustion of dried rabbit tissues contained about 2% of the tritium originally given to the animal. Adipose tissue alone contained little or no exchange tritium. The dried tissues of the other animals were rehydrated with inactive water and the appearance of tritium in the water observed. The specific activity of the water increased in exponential fashion, i.e., 1-exp(kt), with about 90% of exchange occurring with a half-time of 1 hr, and the remaining 10% with a half-time of 10 hr. The total tritium extracted accounted for 1.5 to 3.5% of the dose given to the animal, which agrees with the difference between the tritium space and total body water determined by desiccation. An indirect estimate of exchange in humans was derived from concurrent measurements of tritium and antipyrene spaces. The average difference of about 2% in water volume agrees with the direct estimates of exchanges in animals. It is evident that tritium space should be reduced by about 2% to identify it with total body water. The magnitude and relatively slow rate of exchange may also influence the interpretation of metabolic studies with tritium. (auth)

17383 UTILIZATION OF TRITIUM AND CARBON-14 IN STUDIES OF ISOTOPE EFFECTS. H. S. Isbell, H. L. Frush, and L. T. Sniegoski (National Bureau of Standards, Washington, D. C.). p.93-101 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The utility of tritium in organic research was augmented by the development of a simple method for determining C^{14} and tritium in the same sample. The non-volatile, radioac-

tive material, in a film that is "infinitely thick" to tritium radiation, is counted in a windowless, gas-flow proportional counter; the film is then re-counted when covered with a screen that stops all radiation from tritium but allows a fraction of that from C^{14} to pass. By introduction of one isotope at a point removed from the reaction center, an isotope effect for the other can be determined from changes in the tritium C^{14} ratio in the reactant and/or products as the reaction proceeds. Carriers of reactant, products or derivatives can be added at any point to facilitate isolation, because the analytical method depends primarily on the tritium/C^{14} ratio. Methods for utilizing the double-label technique were illustrated by a study of isotope effects in the oxidation of the penultimate carbon of certain labeled polyols with Acetobacter suboxydans. Six D-mannitols position-labeled either with C^{14} or with tritium at C1, C2, or C3 were prepared. For these, isotope effects (k^*/k) of 0.93, 0.23, and 0.71, respectively, were found with C^{14} at C2, tritium at C2, and tritium at C3; no detectable isotope effects were found for the remaining D-mannitols. In the oxidation of position-labeled D-glucitols, an isotope effect of 0.24 was found for tritium at C5; no detectable effect was found for either C^{14} or tritium at C1. (auth)

17384 THE COMBINED USE OF AUTORADIOGRAPHIC AND ELECTRON-MICROSCOPIC TECHNIQUES FOR STUDIES ON ULTRA-THIN SECTIONS OF TRITIUM-LABELLED CELLS OF THE INTESTINAL EPITHELIUM. J. C. Hampton (Baylor Univ., Houston, Tex.) and H. Quastler. p.103-10 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (BNL-5240). (In English)

The high resolution now obtainable in sectioned cells studied in the electron microscope offers some promise of visualizing some of the intracellular events leading to the synthesis of proteins. The specificity of incorporation of tritiated thymidine into DNA provides a system which can be accurately followed with respect to time and localization within the cell. The work reported demonstrates that it is possible to study ultra-thin sections of labeled cells in the electron microscope, to remove the specimen after suitable electron micrographs have been taken, to apply a coating of emulsion sufficiently thick to obtain an autoradiograph but still thin enough to permit re-examination of the specimen in the electron microscope, and to obtain electron micrographic images of autoradiographs of cells previously recorded. The autoradiographic emulsion was applied as follows: a thin film was formed by dipping a small wire loop into liquid emulsion and transferring the film by passing the loop over the mounted specimen which was fixed to the top of a small plastic peg. Adequate control can be achieved by taking a one-half micron section after each ultra-thin section during sectioning, mounting it on a glass slide and applying conventional autoradiographic techniques. Because of the fragile nature of ultra-thin sections, the yield of successful autoradiographs is quite low. In spite of this objection, it is expected that with improvements in skill and techniques the method will facilitate a better understanding of vital cell processes. (auth)

17385 THE SYNTHESIS OF TRITIUM-LABELLED ADRENAL AND GONADAL HORMONES. P. Osinski (Institut Interuniversitaire des Sciences Nucléaires and Hôpital St. Pierre, Louvain, Belg.). p.113-19 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Partial, catalytic hydrogenation of 1,4-diene-3-keto-steroids yields among other products the adrenal and/or gonadal 4-ene-3-ketones. The cortisol (4-pregnene-11 β, 17 α, 21-triol-3.20-dione) and several of its derivatives labeled with tritium on carbons 1 and 2 have been prepared previously by this method in good yield and high specific activity. The technique of reduction was adapted to the quantities of substrate of the order of 0.1 mmole. This affords better utilization of tritium and easier purification of the final product. A description is given of the preparation of starting material for the synthesis of corticosterone (4-pregnene-11 β, 21-diol-3.20-dione), Reichstein's compound "S" (4-pregnene-17 α, 21-diol-3.20 dione), desoxycorticosterone (4-pregnene-21-ol-3.20-dione), testosterone (4-androstene-17 β-ol-3-one) and androstenedione (4-androstene-3.17-dione). Several solvent systems are described as appropriate for paper chromatographic separation of hydrogenation products. Using tritium gas, all the above-mentioned compounds were prepared with specific activities of 5 to 10 mc/mg. The influence of molecular structure on reaction yield is discussed. Some observations are noted concerning the isotopic effect during the catalytic hydrogenation. Further work is reported on the stability of the label, particularly in the second position and during biological reactions involving ring A reduction. The principal applications are indicated in which this type of labeling can be used successfully. (auth)

17386 EMPLOYMENT OF THE H^3-PROGESTERONE IN THE EXAMINATION OF THE SYNTHESIS OF 17-OH-CORTICOSTEROIDS BY HUMAN PLACENTAL TISSUE. F. Polvani, G. D. Roversi, and R. Silverstrini (Università, Milan and Laboratorio di Microbiologia e Chemioterapia "Farmitalia," Milan). p.121-30 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Tritium-labeled progesterone, as a precursor of the 17-OH-corticosteroids, was used to study the biosynthesis of placental and adrenal steroids. Homogenates from cattle adrenals were incubated with H^3-progesterone for 3 hr in an O_2 atmosphere. Then corticosteroids were extracted according to Meyer's method and chromatographically prepared in Forisil columns and delta 4-3-ketosteroids were localized on chromatographic paper. The latter was soaked in a nuclear emulsion (Ilford K2 "gel form") and was kept at 4°C for 21 days, allowing the formation of H^3-cortisone, H^3-cortisol and of other steroidal-compounds while the photographic development was made evident. The same incubation technique was used in the research on placental homogenates which revealed the radioactivity of recently produced 11-OH-corticoids by means of a gas-filling counter of the single chromatographic spots. (auth)

17387 THE BIOSYNTHESIS OF (16-H^3) STEROID BY ISOLATED ADRENAL CORTEX TISSUE. P. J. Ayres (Middlesex Hospital Medical School, London). p.131-7 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

3β-hydroxypregna-5:16-dien-20-one acetate was hydrogenated with 100 c of tritium gas (98% isotopically pure) as described by Pearlman. This hydrogenation was carried out at the Radiochemical Center, Amersham, England. Hydrolysis and removal of the labile tritium at the 17 position was followed by Oppenauer oxidation to (16-H^3) progesterone mp 121°. The specific activity was 13.4 c/mmole. 8.5 c of (16-H^3) progesterone (200 mg) was incubated with 0x adrenal cortex tissue (4 kg) consisting mainly of zona glomerulosa plus capsule. This tissue has previously been shown to produce a higher aldosterone to cortisol ratio than whole cortex. The adrenal tissue was prepared very rapidly on a machine designed to yield preparation as free from zona

fasciculata as possible. The incubation was carried out in a Krebs-Ringer bicarbonate medium and equilibrated with 7% CO_2/93% O_2. The tissue was shaken in medium without added substrate for half an hour and then the medium was changed for fresh saline plus (16-H^3) progesterone. Incubation was then continued for a further 2 hr. The extraction and isolation of the products were carried out in a manner similar to that previously described. Tritium measurements were carried out by bremsstrahlung emission on a mica-window counter, by windowless flow counter and liquid scintillation (Tricarb counter). The efficiencies were checked by combustion and gas counting using the method of Avivi et al. and comparison with two standard tritiated water samples, one standardized by mass spectrometry at AERE, Harwell, England; the other sample was obtained from the National Bureau of Standards, USA and was standardized by colorimetry. (auth)

17388 STUDIES IN THE BIOGENESIS OF MACROLIDES BY MEANS OF PROPIONIC ACID (1-C^{14}-3-T). H. Grisebach, H. Achenbach, and W. Hofheinz (Universität, Freiburg i. B.). p.139-45 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The fundamental structure of the antibiotic erythromycin consists of a lactone ring in glucosidic connection to two sugars. The regular arrangement of C-methyl groups in erythromycin led Gerzon to believe that the biogenesis of the lactone ring is possibly brought about by seven units of propionate. For investigating this hypothesis, propionic acid, the methyl group of which was labeled with tritium whereas the carboxyl group was labeled with carbon-14 was synthesized. It is shown that, when this acid was added to Streptomyces erythreus, the C^{14}/T ratio in erythromycin (measured with a gas counting tube) was reduced only by 14 to 25% as against the ratio of the propionic acid. When the sugars were split off the C^{14}/T ratio remained constant. Decomposition of the lactone ring by Kuhn-Roth oxidation showed that more than 90% of the tritium was in the methyl groups and more than 90% of C^{14} in those places, which had to be labeled if the propionic acid had been fitted in properly. The advantages of labeling the acid with tritium as well as with C^{14} are also reflected by another concurrent experiment with propionic acid (3-T) and acetic acid, 1-C^{14}. It could be concluded from the changes in the C^{14}/T value that propionic acid is by far more readily taken up by erythromycin than acetic acid. These results and further experiments prove that the lactone ring of erythromycin is, indeed, made up of seven units of propionate. Similar experiments were carried out on the biogenesis of magnamycin. (auth)

17389 THE EFFECT OF TRITIATED THYMIDINE ON THE MORPHOGENESIS OF LATERAL ROOTS. O. L. Stein (Montana State Univ., Missoula) and H. Quastler. p.149-53 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (BNL-5333). (In English)

Along the axis of a primary root exists a series of successive developmental stages of the same organ—the lateral root, a system ideal for assaying effects of various agents on organogenesis. Primary roots of several species grown in H^3-thymidine in various concentrations and for different periods of time show a region devoid of lateral roots which corresponds closely to the region of differentiation at time of treatment. Anatomical analysis combined with autoradiography indicates that "hot" pericycle cells may be capable of 1 or 2 cell divisions before further development of the lateral root is inhibited. There is evidence that a minimum number of cells must be affected before substitution by adjacent cells is eliminated. This may be a function of the length of the cell division cycle and thus prescribe the duration of treatment for the desired morphological effect. Root primordia already established at time of treatment do not appear affected if the amount of radioactivity is chosen discriminately. In Zea mays the effect of "nuclear irradiation" on differentiation was compared with the effect of x rays and gamma irradiation (Co^{60}). In general, the external irradiation results in a more diffuse disturbance of both lateral and primary root growth. When duration of exposure and dose of an external source are properly chosen the internal effect of tritiated thymidine can be approached. The system offers opportunity to discriminate between damage due to nuclear irradiation (genetic effects?) and general irradiation (genetic + physiological?). Pisum sativum and Cucumis sativus were also used. Current work involves autoradiography to determine the amount of chromosomal radiation needed to disturb these developmental processes. (auth)

17390 THE EFFECTS OF BETA RAYS (TRITIUM) ON THE GROWTH OF RICKETTSIAE AND INFLUENZA VIRUS. D. Greiff (Marquette Univ., Milwaukee). p.155-65 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The growth of Rickettsia mooseri (murine typhus) was increased greatly in embryonate eggs containing tritium oxide at levels of 180, 90, and 45 mc/egg and slightly in eggs containing 22.5 mc/egg; the infections in those given 11.2 mc/egg did not differ from the control. The growth of Rickettsia akari (rickettsial pox) was inhibited completely in eggs containing tritium oxide at levels of 180, 90, and 45 mc/egg, and partially in groups containing 22.5 and 11.2 mc/egg. Results similar to the above were obtained following the inoculation of tritium oxide, 1 mc per 10^8 cells, into monolayer cultures of KB cells infected with R. mooseri or R. akari. A decrease in the latent period of the release of influenza virus from the chorioallantoic membranes of embryonate eggs followed the injection of tritium oxide prior to infection with virus. A thousand-fold increase of virus in the chorioallantoic fluids of treated eggs was found 2 hr after the inoculation of the infective agent. When detectable amounts of virus appeared in the chorioallantoic fluids of the control eggs, 8 hr after infection, the ID_{50} of the tritium-treated eggs was $10^{-5.6}$; both series had an ID_{50} of $10^{-7.5}$ 24 hr after infection. The amounts of virus in the membranes of the tritium-treated eggs were increased also. This virus was liberated by moving and washing the membranes, drying the membranes by vacuum sublimation at low temperatures, and rupturing the cells of the membranes by rehydration with distilled water. (auth)

17391 THE INACTIVATION OF ESCHERICHIA COLI BACTERIA LABELLED WITH TRITIATED THYMIDINE. Sonia Apelgot (Institut du Radium, Paris). p.167-78 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

Bacteria of the strain B_1^2 thy $^-$/Sr, which required thymine and are streptomycin-resistant, had their DNA labeled with tritiated thymidine. The radioactivity measurements were made with a liquid scintillation counting system, with two photomultipliers mounted in coincidence. Under these conditions, the efficiency of the measures was 4.5% and the background 130 counts/min. The radioactive bacteria were kept in sealed tubes either at 0°C or at −196°C and their survival studied. These experiments showed that the

radioactive bacteria are inactivated exponentially as a function of the number of tritium atoms disintegrated. The inactivation is temperature dependent. In both cases the killing efficiency per nuclear transmutation was determined and found as very low. The number of ion pairs generated by the β particles emitted as a consequence of the transmutation of H^3 was evaluated and found quite comparable with the one found in the case of x rays. The suicide caused by the H^3 disintegrations seems to be directly linked with the ionizations produced by the β particles inside the bacterial DNA. (auth)

17392 STUDIES ON THE INFLUENCE OF TRITIUM RADIATION ON ANAEROBIC BACTERIA FROM THE BOVINE RUMEN. J. Brueggemann and D. Giesecke (Universität, Munich). p.179-87 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The bacterial flora in the bovine rumen is mainly composed of strictly anaerobic species supplying the host with large amounts of volatile fatty acids (VFA's) as the main energy source. Long time in-vitro irradiations of the flora with T_2O in a so-called "artificial rumen" under anaerobic conditions have shown that doses up to 75 krad had no inhibitory effect on bacterial growth and VFA-production. Stimulatory effects resulting in acceleration of cell division and increased amounts of VFA's were observed after irradiating the resting flora at 0°C with a total dose of about 300 krad within 20 days, but reproducibility was unsatisfactory because of the heterogeneity of the material. Further experiments were carried out on pure cultures of selected strains of rumen bacteria. Doses up to 150 krad (5 days) did not markedly influence anaerobic growth and carbohydrate metabolism. However, if oxygen was present during the irradiation of resting cells a strong reduction in viable numbers was noted. Oxygen per se was found to exert a lethal effect on these species following a logarithmic order of decline. It is assumed that secondary radiation products, especially H_2O_2, are mainly responsible for the action of T_2O on these microorganisms which are devoid of catalase. Some confirmatory results are still to be obtained. (auth)

17393 THE TREATMENT OF CANCER BY A RADIOACTIVE DRUG: TRITIUM-LABELLED TETRA-SODIUM 2-METHYL-1:4-NAPHTHAQUINOL DIPHOSPHATE. D. H. Marrian, Barbara Marshall, J. S. Mitchell, and I. Simon-Ruess (Cambridge Univ., Eng.). p.211-18 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The action of tetra-sodium 2-methyl-1:4-naphthaquinol diphosphate ("Synkavit"-Roche Products) as a radiosensitizer is reviewed together with earlier methods of labeling this and similar molecules. The synthesis of this compound labeled with tritium was accomplished so as to yield a radiochemically pure drug of specific activity 28 c/mmole (1 atom of tritium/molecule). It is shown that this compound enters the living cell very rapidly both in vivo and in vitro and that cultures of malignant cells incorporate the label to a much greater extent than cultures of normal cells under identical conditions. Preliminary investigations on the use of this drug on patients with advanced, and often otherwise, refractory, malignant conditions are described; uptake by the bone marrow is less than by the tumor, sometimes by a factor of 5. (auth)

17394 TRITIUM AND AUTORADIOGRAPHY IN CELL BIOLOGY. J. H. Taylor (Columbia Univ., New York). p.221-8 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Because tritium emits low-energy beta radiation, it is the most useful isotope for high-resolution autoradiography. The relative abundance of hydrogen in most biologically important substances combined with a relatively short half life allows the labeling of cellular components at specific activities that can often be detected at intracellular dimensions by the use of nuclear emulsions. The cells are attached to glass by various cytological procedures and after fixation a wet or fluid photographic emulsion is applied directly to the cell surface and allowed to dry. After exposure the emulsion is developed while still in contact with the biological specimen. The preparation, an autoradiogram, when viewed under the light microscope shows the cellular structures and the location of the isotope with a resolution of less than 1 μm. In this way, the distribution of tritium-labeled deoxyribonucleic acid (DNA) of individual chromosomes was traced through two to three cell divisions. These studies were made possible by the preparation of tritiated thymidine which is a highly selective label for DNA and is quickly depleted when the cell is removed from the environment containing the labeled thymidine. The technique yielded information on the mechanism of DNA replication, structure and reproduction of chromosomes, kinetics of cell division, and, more recently, on the patterns and time sequence in the reproduction of different chromosomes in the same nucleus and the different parts of a single chromosome. All chromosomes studied so far contain two functional sub-units of DNA which are distributed in a semi-conservative fashion during reproduction. The two sub-units are unlike in some structural sense that limits the type of exchanges that may occur among the four sub-units of a reproducing chromosome. Present evidence on sequences leads to the hypothesis that chromosomes reproduce in a genetically controlled sequence. Further evidence on the patterns and mechanism of control of the sequence are being sought along with other related processes that involve the synthesis of chromosomal proteins and the other class of nucleic acids, ribonucleic acids. (auth)

17395 COMPARATIVE AUTORADIOGRAPHIC STUDY OF THE RNA AND PROTEIN METABOLISM WITHIN THE VARIOUS TISSUES AND CELLS OF THE MOUSE WITH TRITIATED RNA PRECURSORS AND LABELLED AMINO ACIDS. Brigitte Schultze and W. Maurer (Universität, Cologne). p.229-36 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Autoradiographic studies are reported of the incorporation of labeled amino acids into the various kinds of cells in mice and rats. The amount of the incorporation into the nucleus and into the cytoplasm was determined by grain counting. The results show that all nuclei within one cell type and the nuclei of different cell types have approximately the same incorporation rate per unit of nuclear volume. That means that the amino acid incorporation within certain limits is generally proportional to the volume of a nucleus. Furthermore, the amino acid incorporation into the whole cytoplasm of the various examined cell-types was found to be 5 to 10 times greater than the nuclear incorporation. Therefore, the blackening distribution on autoradiographs with labeled amino acids can be understood by this simple incorporation scheme in connection with the varying size of the nuclear and cytoplasmatic volume of the different cell types. On the other hand, autoradiographic studies with tritiated cytidine and uridine showed that the incorporation of RNA precursors into the various tissues of mice and rats is proportional to that of amino acids. That suggests that in all cells of the organism there exists a constant ratio be-

tween the size of protein metabolism and the size of (macromolecular) RNA metabolism. The protein metabolism in a cell is generally 20 to 30 times greater than the RNA metabolism. As in the case of amino acids incorporation, the incorporation of tritiated cytidine into the nuclei of one-cell type and into the nuclei of different cell types was found to be approximately proportional to the nuclear volume. (auth)

17396 NUCLEIC ACIDS AND PROTEIN METABOLISM OF BONE MARROW CELLS STUDIED BY MEANS OF TRITIUM-LABELLED PRECURSORS. F. Gavosto (Università, Turin). p.237-46 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The advantages of the use of tritium-labeled compounds in radioautographic technique are discussed. Tritium electrons have a maximal energy of 0.018 Mev, corresponding to about 1 μm range in a photographic emulsion, and consequently they allow the highest possible resolution at a cellular and subcellular level. This is particularly useful for studying metabolic phenomena of tissues which are composed, as in the case of bone marrow, of different cellular types at various stages of differentiation. This technique was used for investigating nucleic acids and protein metabolism of normal and leukemic bone marrow cells. DNA metabolism was studied utilizing a specific precursor, H^3-thymidine. Some significant differences of the percentages of labeled cells were detected by comparing the normal and leukemic elements belonging to the same stage of maturation. In acute leukemia cells, particularly, a strikingly lower incorporation of thymidine was found and these results are taken as evidence of a decreased proliferative capacity of these cells, as compared to normal myeloblasts. With the same technique, RNA and protein metabolism were investigated utilizing H^3-uridine, H^3-leucine, and H^3-phenylalanine as precursors. The existence of a strict interrelationship between RNA and protein metabolism is now fully accepted in cellular biology. The existence of a constant ratio between uridine and amino acids incorporation was also demonstrated in normal bone marrow cells. In acute leukemia cells the incorporation of RNA and protein precursors, although different from case to case, is constantly and significantly lower. Furthermore, the ratio between uridine and amino acids incorporation is constantly altered in these cells. The lower RNA and protein metabolism and its dissociation in acute leukemia cells is discussed in relation to the well-known maturation defect of these cells. (auth)

17397 IN-VITRO METABOLISM OF H^3 THYMIDINE. J. R. Rubini (Veterans Administration Hospital and Southwestern Medical School, Dallas), S. Keller, A. Eisentraut, and E. P. Cronkite. p.247-67 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The in vitro metabolism and fate of the DNA precursor H^3 thymidine, H^3TDR, (1.9 c/mmole) was studied in human leukemic blood and normal dog marrow. New DNA synthesis was estimated by determining the labeling indices and grain counts of cell autoradiograms made from the mixtures at 1 hr. Cell labeling could readily be depressed by adding minute amounts of unlabeled TDR to H^3TDR initially, demonstrating the smallness of the TDR pool. When TDR was added after 20 min to the incubation mixture, no depression of labeling occurred. This 20 min period defines the H^3TDR incorporation period. Supernatants at 1 hr still contained considerable H^3 activity yet failed to label fresh added cells. These "used" supernatants contained H^3TDR as the major H^3 compound, and only small amounts of H^3 thymine; H^3 water was not formed. Speculations on the mechanisms involved are presented. (auth)

17398 THE USE OF TRITIUM-LABELLED THYMIDINE IN STUDIES ON THE SYNTHESIS OF DEOXYRIBONUCLEIC ACIDS. P. A. Bianchi, A. R. Crathorn, and K. V. Shooter (Chester Beatty Research Inst., London). p.269-76 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

In the course of studies on the biosynthesis of DNA, some experiments were performed using Ehrlich ascites cells, examining the uptake and incorporation of H^3-thymidine. After in-vitro incubation of the cells with this compound, autoradiographs of the cells were made and DNA was also isolated and assayed for H^3 activity using a flow counter. A comparison of the two methods of assay showed a marked discrepancy; the H^3 activity per cell, calculated from the autoradiographs, always appeared to be greater than the activity of the isolated DNA. Subsequent flow-counter assay of the activity of washed, homogenized whole cells gave figures which agreed with the autoradiographic assay. It thus appeared that, in this system, the use of autoradiography as a measure for DNA synthesis was open to criticism. Analysis of the bound, non-DNA activity was made and similar studies of total cellular H^3 activity and the activity of isolated DNA were undertaken on other cell types; these also showed similar effects. From this information it is possible to divide the synthetic process into various stages: (1) The initial incorporation of thymidine into the cell; (2) Subsequent phosphorylation in at least two steps; (3) Polymerization of the phosphorylated thymidine into DNA. Thus, although the assumption that the incorporation of thymidine into the cell gives a measure of DNA synthesis is an oversimplification, it would seem that considerable information about the preliminary stages in the process can be obtained by use of this tracer. (auth)

17399 TRITIATED THYMIDINE AS TRACER IN DNA METABOLISM AND CELL DYNAMICS OF EXPERIMENTAL MYELOID LEUKAEMIA. G. Zajicek, A. Rosin, and J. Gross (Hebrew Univ., Jerusalem). p.291-300 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Some findings are reported in which tritiated thymidine (TH^3) was used to follow the cell dynamics in experimental myeloid leukemia and also to investigate the mechanism of its incorporation into the DNA of these and Ehrlich ascites tumor cells. The leukemic cells were labeled in vivo by injecting the TH^3 into the jugular vein. The dose was 1 μc/g/rat. The rate of appearance of the labeled cells in the peripheral blood and in the ascitic tumor of the animal was estimated. In other experiments, the rate of the dilution of the label in the nuclei was evaluated and thus it was possible to estimate the cellular doubling time in the myelocyte population. The dynamics of transfused leukemia cells were investigated by injecting labeled myelocytes into the jugular vein of normal and leukemic rats. Their rate of disappearance from the blood was measured. Various organs were examined for the labeled cells and it was found that soon after injection the cells were mainly trapped by the lungs, later by the spleen and to a lesser extent by the liver. After 24 hr, no labeled cells were detectable in any of the organs. Information was thus obtained on the fate of the leukemic myelocytes in various organs of the normal and leukemic animals. In in vitro experiments, TH^3 was added to the cell suspension in a concentration of 1 μc/ml. In the course of the in vitro labeling, it was observed that the number of labeled cells was 40 times higher than the number of mitoses. (The same was found also after administer-

ing the TH^3 in vivo.) The rate of incorporation of the TH^3 was established. Concentrations between 0.0036×10^{-3} and 1.8×10^{-3} μmole were tested. It was found that the per cent of cells incorporating the label is constant for the various concentrations of thymidine. The number of grains per nucleus increased with the increase of the concentration of the TH^3 administered. After an incubation period which lasted 120 min, no labeled mitosis was found. Further, the incorporation pattern was the same whether the label was added at the beginning of the incubation or after 160 min. Addition of TH^3 to the same suspension at various time intervals did not alter the per cent of labeled cells but the number of grains per nucleus rose after every administration of the TH^3. Not all the cells in the suspension incorporated the same amount of TH^3. Quantitative measurements were made including grain counts, and the results showed that there is probably a deficiency of thymidine available to the leukemic cells in their ascitic fluid. The dichotomy between the synthesis of the full complement of DNA and subsequent division of the cell is discussed. (auth)

17400 USE OF TRITIATED THYMIDINE TO STUDY THE ORIGIN AND FATE OF INFLAMMATORY CELLS. R. S. Speirs, V. Jansen, E. E. Speirs, S. Osada, and L. Dienes (State Univ. of New York, Brooklyn). p.301-26 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

In a series of experiments, mice were injected with tritiated thymidine at various times following a challenging injection of either tetanus or diphtheria toxoid and the number and proportion of mononuclear cells synthesizing DNA at the site of injection determined. It was noted that the increase in mononuclear inflammatory cells was not preceded by a similar decrease in cells synthesizing DNA. This indicates that the majority of inflammatory mononuclear cells must migrate into the inflamed area, presumably from the blood vessels. Inflammatory cells labeled with tritiated thymidine were injected into the site of inflammation, and autopsies performed at various times. Labeled cells were found not only in the inflammatory area, but in the spleen, bone marrow, and lymph nodes. These experiments indicate that as the inflammation subsides, inflammatory cells pass back into the lymphatic and blood vascular systems and eventually some find their way to the hemopoietic tissues of the body. Experiments are reported indicating formation of plasma cells by inflammatory mononuclear cells. These findings are discussed in relation to hemopoiesis. (auth)

17401 APPLICATION OF TRITIATED COMPOUNDS TO THE MIDGE CHIRONOMUS AND SOME ASPECTS OF THE METABOLISM OF SALIVARY GLAND CHROMOSOMES. C. Pelling (Max-Planck-Institut für Biologie, Tübingen, Ger.). p.327-34 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The investigations were carried out on the salivary gland chromosomes of Chironomus tentans. Tritiated compounds (H^3-thymidine, H^3-uridine, H^3-amino acids), injected into the hemolymph of the larvae, should indicate the place of incorporation within the giant chromosomes. After fixation of the salivary glands, autoradiographs of the squash preparations were made. The autoradiographs show that giant chromosomes are most suitable to localize the activity at chromosomal structures with high resolution. DNA synthesis (thymidine), RNA synthesis (uridine) and protein synthesis within the cell could be followed by determining the time and approximately the quantity of incorporation. Contrary to the protein synthesis, the DNA synthesis and the RNA synthesis are restricted to the chromosomes. The essential physiological activity of the chromosomes seems to be represented by RNA synthesis which takes place at certain distinct loci (nuceolar organizers, "Balbiani-rings," puffs, and other chromosomal bands). Some features of RNA synthesis are discussed. (auth)

17402 THE USE OF DIRECT TRITIUM ASSAY TECHNIQUES IN STUDIES WITH TRITIATED THYMIDINE. G. Gordon Steel (Royal Cancer Hospital, Belmont, Surrey, Eng.). p.349-59 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Results are described of investigations into the catabolism of tritiated thymidine in the rat, during the period of its initial localization in tissues, and into the retention of tritium-labeled cells in intestine and bone marrow up to 16 days after labeling. During the first hour after the injection of tritiated thymidine, while the concentration of nonvolatile tritium in most tissues rose to a saturation level, the concentration in liver fell rapidly from an initially high level. Using a device which enabled a sample of tissue water to be extracted from a cold tissue specimen, measurements were made of the specific activity of tritiated water from various organs. By one hour after injection, the tritium concentration was almost constant throughout the body water, but during the period of establishment of this equilibrium, considerable gradients of tissue water specific activity could be detected. In liver, the gradient indicated a flow of tritiated water from the liver into the blood; in spleen, testis, and muscle the flow was from the blood into the tissue. Measurements of tritium retention in intestine and bone marrow after giving tritiated thymidine indicated that in both tissues there was an initial plateau and that the subsequent decay had two prominent exponentials. In bone marrow, the observation of a plateau conflicts with other published work; the plateau is not observed in animals which have received protracted irradiation. (auth)

17403 AUTORADIOGRAPHIC STUDY OF INCORPORATION OF TRITIATED THYMIDINE IN THE RAT. P. Maldague, Pham Hong Que, and J. Maisin (Institut du Cancer, Louvain, Belg.). p.361-72 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

Tritiated thymidine was used to evaluate desoxyribonucleic acid synthesis in various rat organs. It is shown by autoradiographs that this synthesis takes place mainly in tissue having intensive mitotic activity (bone marrow, seminiferous tubules of the testis, mucous membrane of the intestine, esophagus, and tongue). The regeneration of the convoluted renal tubules during the months following local irradiation of the kidney at various doses was also studied. (auth)

17404 RECOVERY OF MICE THYMUS AFTER X-RAYS AND 15 Mev ELECTRONS. COMPARATIVE STUDY OF THE CELL POPULATION USING TRITIATED THYMIDINE. C. Biagini, P. G. Paleani Vettori, and R. Zito Bignami (Università, Rome and C.N.E.N., Rome). p.373-9 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The mechanism of recovery from acute radiation damage may be studied by using two types of radiations which show small differences in the acute RBE and large differences of effect in the recovery phase. As observed in previous experiments, this condition is achieved by comparing the effects in mammals of 150 kv_p x rays and those of 15 Mev electrons produced by a betatron. Results are presented of an autoradiographic study on the behavior of single

classes of cells of the mice thymus by use of tritiated thymidine as DNA precursor. Data are related to the modifications in distribution of the size categories of the cell population and to organ weight. After irradiation, the large to small cell ratio is increased; the incorporation of tritiated thymidine is reduced in large and in small lymphocytes. In the acute phase of effect, no significant differences between x rays and electrons are observed in cell sizes and in labeling of large cells. A relative change appears in labeling of small cells, a fact that may have a relation with the RBE values of fast electrons, in agreement with the organ weight data. In the recovery, less differentiated cells show active proliferation, but the percentage of mature lymphocytes remains small. After exposure to 15 Mev electrons, proliferative activity of large cells is greater, according to the time curves of the thymic atrophy. From the above results, regenerative potentiality appears related to the degree of damage on primitive cells; for a given dose, the latter appears larger after x rays than after electrons. (auth)

17405 TISSUE METABOLISM OF TRITIUM-LABELLED THYROID HORMONES AND THYRONINE. J. Roche, J. Nunez, and Cl. Jacquemin (Collège de France, Paris). p.396-405 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

Deiodation of thyroid hormones results in the formation of iodides and of thyronine (T_0), the description of which has been based on tissue sections or on a thyroxine deiodase preparation. Direct evidence was provided of this process: 3,5,3'-triiodothyronine and 3,3',5'-triiodothyronine, each tritium-labeled at alpha-beta and at 3, result (inter alia, in the kidney) in the formation of T_0. The identification of T_0 as a natural derivative of thyroid hormones justified the study of its tissue metabolism; T_0 which was tritium-labeled at 3,5 was incubated in vitro with sections of kidney and muscle. By liquid scintillation radiochromatography and by radioautography the following were identified: (1) tyrosine, whose formation is evidence of the rupture of the diphenyl ether bridge of T_0; (2) 3'-hydroxythyronine and 3,4-dihydroxyphenylalanine, whose presence shows that 0-hydroxylation occurs in the catabolism of the cycles; (3) thyroacetic acid and p-hydroxyphenylacetic acid, whose appearance is in keeping with the general scheme of alpha-aminated acid degradation. (auth)

17406 THE METABOLISM OF TRITIUM-LABELLED EPINEPHRINE IN MAN. E. H. LaBrosse, J. Axelrod, I. J. Kopin, and S. S. Kety (National Inst. of Health, Bethesda, Md.). p.407-12 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

It was of interest to study the metabolism of epinephrine in normal human subjects. Studies of epinephrine metabolism in animals have indicated the possible routes of its metabolism, but the doses, both of radioactivity and of the catechol amine, have been greater than the levels which are safe to use in humans. Also, earlier studies of the metabolism, of this hormone in humans have been limited by the relatively low specific activity of the labeled epinephrine. The use of tritium-labeled epinephrine (7-H^3-dl-epinephrine-d-bitartrate) has made possible more complete recovery of the administered radioactivity, and the higher specific activity (greater than 300 μc/mg) has allowed isolation and quantification of new metabolites. In twelve normal human males, 92.6 ± 7.7% of the tritium in the infused H^3-epinephrine was excreted into the urine within 54 hr following the infusion of the tritium-labeled epinephrine. The tritium-labeled urinary constituents were as follows: unchanged epinephrine 6.8 ± 1.5%, free metanephrine 5.2 ± 1.1%, metanephrine glucuronide 6.0 ± 1.5%, metanephrine sulfate 29.5 ± 9.0%, 3-methoxy-4-hydroxyphenylglycol 7.1 ± 1.4%, free and conjugated 3,4-dihydroxymandelic acid 1.6 ± 0.6%, and 3-methoxy-4-hydroxymandelic acid 41.2 ± 8.4%. As demonstrated by this and related experiments, the biological application of tritium-labeled epinephrine has made possible a much more complete understanding of the metabolism of this important hormone in humans. (auth)

17407 STUDY ON CHOLESTEROL RENEWAL OF FATTY LIVERS BY MEANS OF TRITIATED CHOLESTEROL. F. Chevallier (Centre d'Études Nucléaires, Saclay, France). p.413-17 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

It is known that ingestion by rats of a diet rich in cholesterol (2%) results in the formation of cholesterol-fatty liver. In the experiments, animals so fed for periods of one to three months were made to ingest the same diet in which the cholesterol had been replaced by tritiated cholesterol of known specific radioactivity. The rats were sacrificed after various ingestion periods up to a maximum of 51 days. Examination of the specific radioactivities of liver and serum cholesterol, free and esterified, gave the same values. Hence, the cholesterol of cholesterol-fatty livers is entirely renewed and does not represent an inert mass in the liver. (auth)

17408 DISTRIBUTION OF TRITIATED TETANUS TOXIN FOLLOWING AN INTRAPERITONEAL INJECTION IN IMMUNIZED AND NON-IMMUNIZED MICE. R. S. Speirs (State Univ. of New York, Brooklyn). p.419-28 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Tetanus toxin, purified by ultra-filtration and precipitation with ammonium sulfate, was lyophilized and exposed to 5 c of tritium gas (Wilzbach procedure) for 2½ days in a deep freeze cabinet at 0.38 atm of pressure. The toxin was then homogenized and the precipitated material removed by filtration through a HA millipore membrane. The filtrate was washed and concentrated in a membrane colloidal dialyzer. The resuspended material (particles estimated to be below 450 mμm in size) was highly toxic when injected into mice. Both the crude precipitate and the suspended toxin were injected into immunized mice and the animals autopsied at various times to determine the presence of radioactivity in the various inflammatory cells. These results were compared with those obtained when the toxins were neutralized and injected into non-immunized mice. In the inflammatory area produced by the injection of tritiated toxin, neutrophils containing radioactivity were found during the first 2 days and macrophages containing radioactivity were found in the spleen as well as in the inflammatory area for as long as 15 days. Trace amounts of radioactivity were found in eosinophils. No radioactivity was found within mast cells in either the immunized or non-immunized animals. The significance of these results is discussed in relation to initiation of antitoxin production. (auth)

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Refer also to abstracts 17406 and 17699.

17409 (HW-72511) METABOLISM AND DOSIMETRY OF CESIUM-137 IN MALE SHEEP. R. O. McClellan, J. R.

McKenney, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1962. Contract AT(45-1)-1350. 17p.

Nine male sheep were used to establish certain metabolic parameters and study the radiation dose from internally deposited Cs^{137}. Between 50 and 80% of the ingested radiocesium was absorbed from the gastrointestinal tract. Following a single oral dose, the fecal and urinary excretion of Cs^{137} were approximately equal. Urine contained concentrations of radiocesium approximately 25 times that of plasma. At equilibrium most of the soft tissues contained Cs^{137} concentrations 10 to 30 times that of plasma. Highest concentrations were found in voluntary muscle, myocardium, testicles, pituitary, bulbourethral glands, kidneys, pancreas, and liver. Cs^{137} turnover rates of about 10% per day were estimated for voluntary muscle and blood cells. Turnover rates apparently exceeded 200% for heart muscle and most other soft tissues. After 5, 10, and 20 days of daily oral administration direct gamma radiation dose was measured in selected tissues. Beta radiation dose rates were calculated from tissue concentration data. The combined beta and gamma radiation dose rates to total body and testes were essentially the same. On this basis "total body" and testes appeared equally important as the critical organs. Approximately 20% of the radiation dose to the testes originated externally. (auth)

17410 (IA-707) THE PHYSIOLOGICAL BEHAVIOUR OF CATIONIC FLUOROCOMPLEXES IN RATS. M. Anbar and N. Ernst (Israel. Atomic Energy Commission, Rehovoth). Jan. 1962. 14p.

The distribution of fluorine activity in various tissues of rats was investigated using NaF^{18} in the presence of EDTA, zirconium, scandium, and yttrium ions. The patterns of fluorine distribution and excretion were found to be altered by cations which form stable fluorocomplexes and by EDTA. Application of the results in bone pathology is discussed. (auth)

17411 (USNRDL-TR-555) MONOVALENT CATION EFFECTS ON A DNA-SYNTHESIZING SYSTEM. R. K. Main and E. R. Walwick (Naval Radiological Defense Lab., San Francisco). Apr. 2, 1962. 20p.

The rate of incorporation of tritiated thymidine into DNA, in a multienzyme (predominantly cytoplasmic) system derived from rat thymus, is strongly affected by the nature and concentration of certain monovalent cations, tested one at a time, in the incubation mixture. The data indicate a narrow pH-activity range with a pH optimum at 7.3. K^+, at 50 to 60 mM concentrations, can increase the rate of thymidine incorporation into DNA by a factor of 3.4 over that attained in its absence; Na^+, causes a 2.5-fold increase. Under optimum conditions, maximum stimulation of DNA synthesis by selected cations increases in the order, Li^+, Na^+, C_s^+, Rb^+, NH_4^+, and K^+. These are specific ion effects. Under standard conditions, the rate of DNA synthesis catalyzed by this multienzyme system reflects the degree of denaturation of the DNA primer. Undenatured DNA exhibits little, if any, primer activity. After prolonged water-dialysis at 2°C, DNA acquires primer properties in a degree proportional to the amount of dialysis. For primer purposes, thermal denaturation (100°C for 7 minutes) is superior to water-dialysis (80 hours at 2°C). Preliminary experimental evidence suggests that the K^+-dependence, demonstrated for this thymus (cytoplasmic) multienzyme system, is a property of the polymerase system present therein. (auth)

17412 STUDIES OF METAL COMPLEXES OF RADIOBIOLOGICAL INTEREST. I. THE ACIDITY CONSTANTS OF CROCONIC ACID. Birger Carlqvist and David Dyrssen (Research Inst. of National Defence, Stockholm). Acta Chem. Scand., 16: 94-104(1962). (In English)

Potentiometric and spectrophotometric methods were used for the determination of the dissociation constants of croconic acid at 25°C. The potentiometric method gave only approximate values of pK_1 0.3–0.5 and pK_2 1.4–1.6 (2 M (H, Na)Cl) and $pK_1 \simeq 0.6$ and $pK_2 \simeq 1.8$ (0.1 M (H, Na) Cl). The ultraviolet spectra of croconic acid were determined in mixed solutions of 2 M HCl and 2 M NaCl. The absorption data were treated by two methods: The graphical method for testing reasonable values of the molar extinction coefficients of H_2A and HA^-. The slope and intercept of the best straight lines corresponded to $pK_1 = 0.2–0.3$ and $pK_2 = 1.3–1.5$. The least squares technique using a high-speed digital computer for determining a set of parameters giving the minimum standard deviation. This minimum was obtained for $pK_1 = 0.32$ and $pK_2 = 1.51$. In addition the spectra for the H_2A and HA^- forms of croconic acid were obtained by this method. (auth)

17413 RADIOIODINE EXCRETION STUDIES IN FILIPINOS. I. THE NORMAL RANGE OF EXCRETION OF RAI FOR FILIPINOS. Augusto D. Litonjua, Paulo C. Campos, Emilio Horrilleno, Jose Corpuz, Irineo Lawas, and Benjamin Baltazar (Univ. of the Philippines, [Manila]). Acta Med. Philippina, 12: 239-47(Apr.-June, 1956). (In English)

Results are summarized from measurements of iodine-131 in 136 subjects with various thyroid conditions. The normal range of iodine-131 excretion for 24-hr after the administration of a tracer dose was set at 23.4 to 60.0%. Iodine-131 excretion is recommended as a reliable test of thyroid function. (C.H.)

17414 RADIOIODINE EXCRETION STUDIES IN FILIPINOS. II. CORRELATION STUDIES. Augusto D. Litonjua, Paulo C. Campos, Emilio Horrilleno, Jose Corpuz, Irineo Lawas, and Benjamin Baltazar (Univ. of the Philippines, [Manila]). Acta Med. Philippina, 12: 249-60(Apr.-June, 1956). (In English)

Results are presented of a survey on the correlation between the excretion of iodine-131 and several other thyroid function tests. Only hyperthyroid subjects showed a significant negative correlation between first 24-hr excretion of iodine-131, protein-bound-iodine-131, and basal metabolism rate measurements. (C.H.)

17415 DISTRIBUTION AND EXCRETION OF RADIOCESIUM IN GOATS, PIGS AND HENS. Lars Ekman (Royal Veterinary Coll., Stockholm and Research Inst. of National Defense, Stockholm). Acta Vet. Scand., 2: Suppl. 4, 1-83(1961). (A/AC.82/G/L.754) (In English)

The pattern of distribution in tissues and excretion of Cs^{134} was studied in goats, pigs, and hens. The influence of K on the metabolism of Cs^{134} was studied by stable K determinations and by double tracer tests with K^{42} and Cs^{134}. The results led to the conclusion that the cellular uptake of Cs differs from that of K, Cs being more readily accumulated in all tissues except blood cells and brain. The significance of Cs^{134} as a fission product incorporated in the food chain is discussed. (85 references.) (C.H.)

17416 THE ABSORPTION OF CALCIUM, STRONTIUM, BARIUM AND RADIUM FROM THE GASTROINTESTINAL TRACT OF THE RAT. D. M. Taylor, P. H. Bligh, and Mary H. Duggan (Royal Cancer Hospital, London). Biochem. J., 83: 25-9(Apr. 1962).

The absorption of Ca, Sr, Ba, and Ra from the gastrointestinal tract of the rat was studied by means of double radioactive tracer techniques. At 14–18 days of age there

is almost complete absorption of calcium and strontium and about 80% of barium and radium is absorbed. For animals 6–8-weeks old absorption of Ca decreased to about 60%, Sr to 25%, Ba to 7% and Ra to 11%. In animals at 60–70 weeks of age the absorption of all the elements except barium is decreased to between one-third and one-half of these levels. Deprivation of food before administration markedly increases the absorption of barium and radium and slightly reduces calcium absorption. Administration of the elements in cow's milk significantly enhances the absorption of calcium and, more particularly, strontium in 6–8-week-old rats. The absorption of barium and radium is not affected and the effect is not observed in old animals. The results for the absorption of barium and radium show a closer similarity to each other than to the results for strontium and calcium. (auth)

17417 EFFECT OF DIETARY ZINC ON THE ABSORPTION OF ORALLY ADMINISTERED Zn^{65}. J. E. Furchner and C. R. Richmond (Los Alamos Scientific Lab., N. Mex.). Health Phys., 8: 35-40(Feb. 1962).

An attempt to modify the absorption of oral Zn^{65} in rats was made by the addition of natural zinc acetate to the diet of male Sprague-Dawley rats. After the rats were maintained on a zinc-supplemented diet for 4 weeks, an oral dose of $Zn^{65}Cl$ was administered to the rats. The retention of Zn^{65} was determined by whole-body assay techniques. Differences in per cent Zn^{65} retained were attributed to differences in the zinc acetate level in the diet. Data from 1 human subject suggest that intestinal absorption may be decreased by increasing dietary zinc levels. (auth)

17418 EFFECTS OF NITROGEN MUSTARD ON MOUSE TISSUE AND MODIFICATION BY AET. M. Asano, T. P. McDonald, and T. T. Odell, Jr. (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol., 4: 591-600(Feb. 1962). (In English)

Clinical and pathological effects were investigated in RF/Up mice injected intravenously with a radiomimetic agent, nitrogen mustard, as well as the protection from these effects afforded by a radioprotective agent, aminoethylisothiuronium (AET). The effectiveness of HN2 was reduced about 40% by pre-injection with 9.0 mg of AET per mouse, raising the $LD_{50}/30$ days from 0.127 to 0.203 mg per mouse. Symptoms of HN2-toxicity were also reduced through the use of AET, as was damage to tissues, especially cerebral, hemopoietic, and gastro-intestinal. Recovery began earlier and was more rapid in AET-treated mice. Although the specific cause of death was not ascertained, the results suggested that damage to the central nervous system probably played a significant part. (auth)

17419 THE TURNOVER OF CALCIUM AND STRONTIUM IN THE SKELETONS OF GROWING RATS ON HIGH-STRONTIUM DIETS. G. E. Harrison, Krista Kostial-Simonović, and G. R. Howells (Medical Research Council, Harwell, Berks, Eng.). Intern. J. Radiation Biol., 4: 623-36(Feb. 1962). (In English)

The deposition of strontium in the skeletons of rats of three different age groups was investigated. The rats were fed for 21 days on special diets differing from a commercial rat-diet only in that equimolar substitutions of strontium for calcium were made. At the end of the feeding period there was an approximate equilibrium between the calcium and strontium in the diet and the calcium and strontium in bone. On diets in which the strontium to calcium ratio was small, the over-all discrimination (bone to diet) varied from 0.27 to 0.33, indicating a preferential deposition of calcium rather than strontium in bone. This discrimination decreased slightly with increasing age. It is postulated that equilibration of bone calcium and strontium with dietary calcium and strontium takes place only in a labile fraction of the skeleton which is computed to be 23% of the bone calcium in young rats and 6% in adults. This labile fraction is shown to be composed of about equal parts of pre-formed but still labile bone and new bone laid down over the feeding period (growth). The implications of these results on the deposition of Sr^{90} in the skeleton are discussed. (auth)

17420 COMPARATIVE METABOLISM OF TRITIATED WATER BY MAMMALS. C. R. Richmond, W. H. Langham, and T. T. Trujillo (Los Alamos Scientific Lab., N. Mex.). J. Cellular Comp. Physiol., 59: 45-53(Feb. 1962).

Tritiated water was used to measure the volume and turnover of exchangeable body water in 7 species of adult mammals. Using these parameters, the daily turnover of exchangeable body water was calculated for each species. Body water content was about 60% of body weight for all species. Biological half-times for turnover of body water varied from 1.1 days for mice to 9.5 days for man. The longest biological half-time observed was about 12 days for desert Kangaroo rats (Dipodomys deserti). Values for the volume and turnover of body water for the various species are compared with values reported in the literature. An interspecies correlation of the power function type between daily water turnover and species weight was established. Body water turnover was found to vary as the 0.80 power of body weight for all species except the desert rat. A parabolic interspecies correlation was also established between total body water and total body solids for the 7 species. The relative partition of water and solids in adult mammals is constant with a value of 1 when expressed interspecifically. (auth)

17421 STUDY ON RADIOCOLLOIDAL THERAPY; YTTRIUM-90 CHLORIDE. A. Nagatsuka (Univ. of Tokyo Faculty of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1657-77(1960).

Radioyttrium chloride was injected into the pleural or peritoneal cavities of patients with far-advanced cancer. The dosage of radioyttrium for intraperitoneal injection was usually 20 to 50 mC at 7- to 10-day intervals. Statistical results have not yet been obtained. However, the malignant cells in the effusions decreased in all cases, and the rate of fluid formation was decreased in 2 cases of bladder cancer, 1 of breast cancer, 1 of cecal tumor, 1 of ovarian tumor, 2 of leukemia, and 1 of carcinomatous pleuritis. In a case of chronic myelogenous leukemia there was improvement of the peripheral blood picture and reduction of the size of the spleen. (Abstr. Japan Med., 2: No. 3, March 1962)

17422 MAXIMUM ALLOWABLE CONCENTRATIONS OF TOXIC SUBSTANCES IN INDUSTRIAL ATMOSPHERES. Kazuya Horiuchi (Osaka City Univer. Medical School). Osaka City Med. J., 7: 63-82(1961).

Maximum allowable concentration (MAC) of toxic substances indicates the maximum average atmospheric concentration of contaminants to which workers may be exposed during on eight-hour working day without injury to health. Efforts by national and international committees to establish MAC values for a number of substances are reviewed. Attempts to set up MAC values for Pb in the air of workshops are described. The importance is stressed of suitable methods of physical or chemical analysis. (C.H.)

17423 POSTIRRADIATION URETERAL OBSTRUCTION. Ryszard Roessler. Polski Przeglad Radiol. i Med. Nuklearmej, 26: 165-70(Mar.-Apr. 1962). (In Polish)

Fourteen cases of ureteral obstruction due to radiation therapy in gynecological cancers are discussed. Ureteral obstruction was diagnosed in 11 cases, in two cases there was the stricture of the intramural part of the ureter and in one case the ureter was dilated with the resulting vesico-renal reflux. The onset of the lesion is slow and insiduous. The early symptoms of the lesion are pains in the lumbar region and in the lower abdomen the late ones are uraemia terminating in anuria. The early stages of the disease may be cured by some local procedures, but the late call for surgical intervention. It is believed that the lesion may be prevented by large doses of tocopherol given during the radiotherapy. (auth)

17424 Ca^{45} UPTAKE IN FRACTURE CALLUS OF NORMAL AND AMINOACETONITRILE-TREATED RATS. Lorenzo Bolognani and I. V. Ponseti (State Univ. of Iowa, Iowa City). Proc. Soc. Exptl. Biol. Med., 109: 933-5 (Apr. 1962).

Calcium content and Ca^{45} uptake were measured in the fracture callus of normal and AAN-treated rats. It appears that total calcium deposition and Ca^{45} uptake are both higher in the young callus, 5 and 10 days after fracture, of the AAN-treated animals. By the 20th day, mineralization of the callus in both groups is similar. (auth)

17425 MOLECULAR WEIGHTS OF HUMAN PROTHROMBIN AND THROMBIN BY ELECTRON IRRADIATION. David L. Aronson and John W. Preiss (National Institutes of Health, Bethesda, Md.). Radiation Research, 16: 138-43(Feb. 1962).

An attempt was made to estimate the molecular weights of human thrombin and prothrombin by applying target theory. Samples of purified thrombin and prothrombin were irradiated after freeze-drying and after drying from the liquid state. The estimated molecular weights freeze-dried and dried as liquid were 35000 and 79000 and 70000 and 70000 for thrombin and prothrombin, respectively. It is felt that the molecular weight value of 35000 represents the true molecular size of thrombin. (P.C.H.)

17426 THE EFFECTS OF FEEDING IRRADIATED FLOUR TO DOGS. II. REPRODUCTION AND PATHOLOGY. Elwood F. Reber, Om P. Malhotra, J. Simon, J. P. Kreier, P. D. Beamer, and H. W. Norton (Univ. of Illinois, Urbana and Illinois Agricultural Experiment Station, Urbana). Toxicol. Appl. Pharmacol., 3: 568-73(Sept. 1961).

Groups of two male and two female beagle dogs were fed a complete ration of which 35% of the total solids was nonirradiated flour (FO) or flour irradiated with 37,200 (FX) or 74,400 (F2X) rads. The dogs were fed the rations during a 104-week period. There was no statistically significant difference in the initial weight, weight gained, or feed consumed between the dogs fed irradiated flour and those fed nonirradiated flour. All the females and males were fertile. The bitches whelped 21, 13, and 16 pups and weaned 9, 1, and 5 pups in the FO, FX, and F2X groups, respectively. Including irradiated flour in a ration fed to dogs had no apparent effect on the blood level of hemoglobin, nor on red blood cell, white blood cell, or differential white blood cell counts as compared to the blood values of the dogs fed nonirradiated flour. Thyroid lesions increased with increasing level of irradiation, but the data are too few to achieve statistical significance. Flour irradiated with 74,400 rads is wholesome since including it in a ration fed to dogs had no significant detrimental effect on the basis of the criteria used in this experiment. (auth)

17427 THE EFFECT OF BERYLLIUM SULFATE ON CHLOROFORM-INDUCED HEPATIC NECROSIS IN MICE. G. E. Paget (Imperial Chemical Industries Ltd., Macclesfield, Ches., Eng.). Toxicol. Appl. Pharmacol., 3: 595-605(Sept. 1961).

Experiments on mice are described in which the hepatic necrosis which follows a substantial dose of chloroform is almost completely inhibited when the animals are dosed with beryllium sulfate before the administration of chloroform. It is suggested that this inhibition of chloroform liver necrosis is due to reticuloendothelial blockade produced by beryllium. (auth)

17428 THE EFFECTS OF FEEDING IRRADIATED PORK, BREAD, GREEN BEANS, AND SHRIMP TO RATS ON GROWTH AND ON FIVE ENZYMES IN BLOOD. Myron Brin, A. S. Ostashever, and H. Kalinsky (Food and Drug Research Labs., Inc., Maspeth, N. Y.). Toxicol. Appl. Pharmacol., 3: 606-17(Sept. 1961).

Four x-irradiated foods were fed to individual groups of rats over a 12-week period. Pork, green beans, and shrimp had each been exposed at each of two levels, 2.79 and 5.58 megarad, and the bread was exposed to each of two lower levels, 25 and 50 kilorad. Pork, green beans, and shrimp were fed at a level of 35% of the diet on a dry weight basis. In addition, bread, green beans, and shrimp were fed at a level of 80% on the diet on a dry weight basis. All diets were adequately supplemented with vitamins and minerals and in the case of green beans with additional protein. After the 12-week feeding period the following blood enzyme systems were studied: erythrocyte transketolase, plasma transaminase, erythrocyte glycolysis, erythrocyte respiration in the presence of methylene blue, and erythrocyte glutathione reductase. Growth and blood enzyme levels of rats fed irradiated foods were similar to those fed the unirradiated control material. No signs of toxicity related to the food irradiation were noted. (auth)

17429 TOXICITY OF BERYLLIUM COMPOUNDS. Lloyd B. Tepper, Harriet L. Hardy, and Richard I. Chamberlin. Elsevier Monographs on Toxic Agents. Amsterdam, Elsevier Publishing Co., 1961. 199p.

Data on the toxicology of Be are summarized. The pathology, diagnosis, and treatment of acute and chronic beryllium disease and other pathological effects of Be are discussed. Industrial hygiene aspects of Be toxicology are reviewed. (C.H.)

Fallout and Ecology

17430 (A/AC.82/G/L.756) DETERMINATION OF STRONTIUM-90 AND STABLE STRONTIUM IN BONES FROM SHEEP EWES AND FETUSES. S. Haeggroth and G. Hoeglund (Sweden. Försvarets Forskningsanstalt, Stockholm). Feb. 1961. 11p.

The concentration of Sr^{90} and stable strontium was measured in bone ash from pregnant sheep ewes (metatarsal diaphyses and vertebrae) and their fetuses (ossified parts of the long bone diaphyses). The fetuses weighed from 125 g (Sr^{90}) and 110 g (stable strontium) to 2650 g. (auth)

17431 Sr^{90}, Zr^{95}, AND Cs^{137} ACCUMULATION IN CORN PLANTS AS INFLUENCED BY SOIL TEMPERATURE. Agron. J., 54: 278-9(May-June, 1962).

The accumulation of Sr^{90}, Zr^{95}, and Cs^{137} by young corn plants as influenced by soil temperature was studied in greenhouse experiments. Soil temperature had a significant influence upon the accumulation of Sr^{90} and Cs^{137} by 3-week-old corn plants, with highest levels occurring at 70°F. No measurable uptake of Zr^{95} was found at any soil temperature. (C.H.)

17432 MEASUREMENT OF THE RADIOACTIVITY OF ZOOPLANKTON OF THE ADRIATIC AND LIGURE SEA FISH FROM MAY 1961 TO JANUARY 1962. E. Cerrai (CISE, Milan), L. Pelati, B. Schreiber, and C. Triulzi. Energia nucleare (Milan), 9: 173-5(Mar. 1962). (In Italian)

Results indicate that radioactivity of the plankton increase more for fish caught in September 1961 than any other period. Such radioactivity is attributable to production of fission product in the seas from fall-out originating from nuclear explosions. (N.W.R.)

17433 IDENTIFICATION OF α-EMITTERS IN NORMAL BIOLOGICAL MATERIALS. C. R. Hill (Royal Cancer Hospital, London). Health Phys., 8: 17-25(Feb. 1962).

Preliminary results of an α spectroscopy program being carried out on natural levels of α activity in humans and their environment are reported. The natural fall-out mechanism for Pb^{210} and Po^{210} leads to a rather high, rainfall-dependent concentration of these nuclides in foliage, and their subsequent uptake into the tissue of grazing animals was detected. A limited number of samples of human foods and drinking waters was examined and the presence in them of varying proportions of Ra^{226}, Ra^{228}, Po^{210}, and uranium is reported. In bone and many of the soft tissues of normal, unexposed human subjects, Po^{210} appears to be responsible for a large part of the total natural activity, while thorium and uranium isotopes, and possibly Pu^{239}, were detected in normal lungs. Results are also reported of similar measurements on the tissues of two subjects with histories of occupational exposure to uranium ore and radium. (auth)

17434 THE UPTAKE AND RELEASE OF RADIOACTIVE STRONTIUM BY FRESHWATER PLANTS. M. Owens, N. S. Thom, and G. E. Eden. Proc. Soc. Water Treatment Exam., 10: Pt. 1, 53-65(1961).

Laboratory experiments using a local hard river water enriched with Sr^{89} were used in studies of total strontium uptake in 7 days by several freshwater plants and of rate of strontium uptake by watercress (Nasturtium officinale). In the latter, rates of uptake were determined for excised shoots and terminal leaflets, the latter concentrating Sr^{89} about 5 times as fast as the excised shoots. The distribution of Sr^{89} within the watercress shoots was also determined. It was found that the concentration factor for Sr^{89} remained fairly constant with varying activity of the medium. Concentration by dead leaflets was immediate and the same as for living leaflets after 48 hours of growth in the contaminated medium. Temperature was found to have a profound effect on Sr^{89} uptake whereas light did not. Also the uptake rate in soft water was found to be very much greater than in hard water. Studies were made of the release of Sr^{89} in uncontaminated water by living and dead leaflets and living leaflets which had been exposed to contaminated water for varying periods of time. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962).

Radiation Effects on Living Tissues

Refer also to abstracts 17389, 17390, 17391, 17392, 17393, and 17404.

17435 (A/AC.82/G/L.750) ON THE HIROSHIMA AND NAGASAKI EXPERIENCE OF NUCLEAR WEAPONS INITIAL RADIATION LD_{50} FOR MAN. U. Ericsson (Sweden. Försvarets Forskningsanstalt, Stockholm). Oct. 1961. 9p.

The available data on initial radiation doses, shielding, and radiation death in Hiroshima and Nagasaki were used to estimate the air dose to humans for 50% death rate. The very limited data indicate a dose between 500 and 1000 rem. The mechanisms producing this high LD_{50} value are briefly mentioned. (auth)

17436 (AD-266312) NUTRITION AND RADIATION INJURY: AN ANNOTATED BIBLIOGRAPHY. Library Bulletin No. 6. Doris Howes Calloway and Lore Rose David (Quartermaster Food and Container Inst. for the Armed Forces, Chicago). July 1961. 133p.

Five hundred and forty-one references are given to bring together information on the relationships among diet, nutritional status, radiosensitivity, and radioprotection; and to suggest profitable areas for future research. Several sources for review of the radiation syndrome are listed. A sampling of papers dealing with the various animal groups investigated are also included. Discussions of metabolic behavior of each of these following exposure to irradiation are given in most of these. A few entries were annotated where the observations are not cited in common texts and are pertinent to specific topics covered later, or to nutrition studies in general. References to tissue levels and excretory patterns are presented briefly under each nutrient category. Representative reviews on chemical protection, and some source material on the problems associated with the investigation of the product of fall-out are given. In the case of cystine, cysteine, and related thio-amines those investigations in which the compounds were administered by mouth, where comparisons with other nutrients were made, or if the data were atypical were annotated. The many successful trials are shown by title only in the interest of conserving space. (auth)

17437 (FTD-TT-62-362) POST-TRAUMATIC DEGENERATION AND REGENERATION OF SYNAPSES AFTER THE EFFECT OF IONIZING RADIATION. V. P. Babmindra. Translated from Byull. Eksptl'. Biol. Med., 46: No. 1, 112-17(1962). 10p.

A study of the processes of degeneration and regeneration of interneuron synapses under irradiation was made with cats. The cats were operated on 3 days after irradiation with single doses of 30, 80, 100, or 500 r. The operation consisted of transecting the sympathetic trunk in the neck 1 mm caudalward from the superior cervical ganglion. In animals irradiated with 30 r, all stages of the degenerative process set in considerably earlier than in the controls. In animals irradiated with 100 r, no noticeable changes of the degeneration periods of the synapses were observed in comparison with control animals. A further increase in the radiation dose led to a distinct inhibition of the degeneration of synapses. With an increase in the radiation dose the scar tissue became less dense and its dimensions began to shrink. Restoration of synapses after the action of small doses of radiation was accelerated from 20 days in nonirradiated animals to 17 days in those irradiated. Average doses slightly inhibited regeneration, and large doses sharply inhibited it. By comparing the process of regeneration of synapses in nonirradiated animals with those irradiated, it was noted that in the first case the regenerating fibers, having made contact with the neurons, later changed little morphologically, whereas in the irradiated animals this primary contact underwent considerable reconstruction. (M.C.G.)

17438 (JPRS-12921) SELECTED ARTICLES ON RADIOBIOLOGICAL ACTIVITY FROM "VOPROSY TSITOLOGII I OBSHCHEI FIZIOLOGII" (PROBLEMS OF CYTOLOGY AND GENERAL PHYSIOLOGY). [Yu. I. Polyanskii, ed.]. Translated from a publication of the

Publishing House of the Academy of Sciences, U.S.S.R., Leningrad, p.80-5; 368-90(1960). 47p.

Separate abstracts have been prepared on 3 translated articles on various aspects of radiobiology. (C.H.)

17439 (JPRS-12921(p.1-11)) SIGNIFICANCE OF CHANGES ORIGINATING IN AN IRRADIATED AQUEOUS MEDIUM DURING THE PROCESS OF INJURING CELLS BY IONIZING RADIATION. E. Ya. Graevskii (Grayevskiy) and A. I. Shul'mina. Translated from p.80-5 of "Voprosy Tsitologii i Obshchei Fiziologii."

Data are presented that attest to the fact that under the effect of ionizing radiation the aqueous medium acquires toxicity in regard to infusoria. Irradiated, they manifest greater sensitivity to an irradiated medium in comparison to the non-irradiated ones. A culture medium, irradiated in a vacuum, similarly to the one irradiated under usual conditions in a vacuum, similarly to the one irradiated under usual conditions with the addition of catalase, manifests no toxicity to Paramaecia. Upon addition to the non-irradiated medium of hydrogen peroxide in a concentration of 3 microns/ml and higher, a progressive toxicity to infusoria is elicited, which does not differ appreciably from the toxicity of an irradiated medium with an equivalent content of hydrogen peroxide. Hence, the toxic factor originating under the effect of ionizing radiation in water is hydrogen peroxide. The above cited data show that, upon irradiation of biological objects, especially in cases where they represent unprotected cells and their concentration in water solutions is not strong enough, a substantial part of the effect is caused by hydrogen peroxide originating within the irradiated medium and that it is not connected with direct effect of radiation energy on the cell. According to the data in the literature, the radiosensitivity of catalase, high in diluted solutions, may undergo a substantial change depending on the medium and irradiation conditions. The marked increase of radiosensitivity of catalase, similarly to many other organic compounds upon transition from a live system to aqueous solutions, is probably connected with the fact that, in the first case, their destruction is caused by the products of water radiolysis which in a living cell either do not originate in sufficient quantities, or are checked by more reaction-prone compounds. (auth)

17440 (JPRS-12921(p.12-33)) CYTOCHEMICAL SIGNS OF RADIOBIOLOGICAL REACTIVITY OF THE NERVOUS SYSTEM AND THEIR FUNCTIONAL SIGNIFICANCE. A. L. Shabadash. Translated from p.368-81 of "Voprosy Tsitologii i Obshchei i Fiziologii."

Histochemical investigations of the ribonucleoproteins (RNP) of neural cells (their mitochondria, in the first place) revealed considerable evidence of physicochemical changes during the early stages of radiobiological reactivity. Definite isoelectric point (IEP) changes of the mitochondria of ribonucleoproteins are seen as early as within the first 30 minutes following a single total irradiation, and they are more pronounced in the afferent system; they disturb the coordination of the intracellular enzymic processes, the oxidation phosphorylation in particular. The impaired metabolism in the neurons is accompanied by a lower excitability threshold which finally leads to the worsening of the state of higher regulating mechanisms of the central nervous system (starting with the reticular system and mesencephalon and ending with the cortex of the large hemispheres). The radiation sickness of higher organisms should be evaluated as a special type of cyclic trophoneurosis with extreme inhibition of the regenerative processes. The presented data and general concept permit a more thorough and precise characterization of the initial alteration phases of the processes during the latent period of an apparent clinical well-being, i. e., during the period of minimal external manifestations of the factual biological reactions. The task of modern radiobiology consists of a correct evaluation of the evolutionally complicated characteristics of the response of various organisms to penetrating radiation, with the view of organizing a successful control of the radiation danger. (auth)

17441 (JPRS-12921(p.34-46)) THE EFFECT OF RADIATION ON BIOLOGICAL PHENOMENA (ATOMIC ENERGY AND BIOLOGY). E. Ernst. Translated from p.382-90 of "Voprosy Tsitologii i Obshchei Fiziologii."

The role of radiation in the origin of functioning living matter is discussed. Mechanisms are considered by means of which animals may convert external effects of radiation to internal impulses. Topics discussed in detail include the origin of simple organic structural elements under the effect of radiation, the origin of organic polymers under the effect of radiation, physiological processes induced by radiation, the effect of radiation on the phenomenon of semiconductivity, and the relation between radiation energy and biological energetics. (C.H.)

17442 (JPRS-13288) BACKGROUND IRRADIATION OF THE HUMAN BODY. Yu. V. Sivintsev. Translated from "Fonovoe Obluchenie Chelovecheskogo Organizma" Moscow, 1960. 109p.

The various components of external and internal background irradiation of the human body are calculated on the basis of experimental data from the literature. The background doses in the gonads, bones, and lungs are determined and compared with dangerous genetic and carcinogenic doses. It is shown that the background dose can be taken as a basis for analysis of permissible levels of irradiation. A bibliography of 226 references is included. (D.L.C.)

17443 (JPRS-13342) PATHOLOGICAL PHYSIOLOGY AND EXPERIMENTAL THERAPY. Translation of Excerpts from Patol. Fiziol. i Eksptl'. Terap., 5: No. 6, 3-4; 21-5; 30-2; 36-9; 62-5(1961). 32p.

Seven papers translated from Patologicheskaya Fiziologiya i Eksperimental'naya Terapiya (Pathological Physiology and Experimental Therapy), Vol. 5: No. 6, Moscow, 1961, are presented. Topics covered include tasks of pathological physiology during large-scale building of communism, changes in nervous system of irradiated animals under the effect of interoceptive stimulation, effect of hibernation and hypothermia on hemotransfusion shock, effect of high air temperature on the emergence of decompression disease, the course of peptone shock in radiation sickness, characteristics of radioinduced humoral agents, and a model of burn cachexia in laboratory animals. Separate abstracts were prepared for three papers. (M.C.G.)

17444 (JPRS-13342(p.4-11)) ON CERTAIN CHANGES OCCURRING WITHIN THE NERVOUS SYSTEM OF IRRADIATED ANIMALS UNDER THE EFFECT OF INTEROCEPTIVE STIMULATION. N. S. Delitsyna. Translated from Patol. Fiziol. i Eksptl'. Terap., 5: No. 6, 21-5(1961).

The conditions originating on interoceptive stimulation in the splanchnic nerve, hypthalamic area, and the cerebral cortex of the large hemispheres of irradiated animals were compared. The studies were carried out by the electrophysiological method on 11 rabbits. Examination of the animals using the stimuli was conducted prior to and after their total irradiation with filtered x rays in a 700 to 1000 r dose. Data obtained attested to the presence of deep changes in various areas of the interoceptive analyzer under

the effect of ionizing radiation. The direction of these changes in various links of the nervous system at various stages of radiation sickness was demonstrated. (M.C.G.)

17445 (JPRS-13342(p.23-4)) ON THE PROBLEM OF THE COURSE OF PEPTONE SHOCK IN RADIATION SICKNESS. I. I. Krivenko. Translated from Patol. Fiziol. i Eksptl'. Terap., 5: No. 6, 62-3(1961).

Dogs weighing from 6.1 to 20.2 kg were subjected to total irradiation daily for 30 to 45 days to a total dose of 450 to 660 r. In seven control dogs, intravenous injection of a 40% solution of peptone induced a rapid and deep fall of arterial pressure. The course of peptone shock against a background of developing radiation sickness was studied on seven dogs. At the moment of administration of peptone, a marked transitory excitation of the animal took place. The excitation lasted for 1 to 1½ sec and was followed by depression phenomena, with a considerable reduction of corneal and pupillary reflexes. (M.C.G.)

17446 (JPRS-13342(p.25-7)) ON THE CHARACTERISTICS OF HUMORAL AGENTS WHICH FORM UNDER THE EFFECT OF IONIZING RADIATION. A. G. Sverdlov. Translation from Patol. Fiziol. i Eksptl'. Terap., 5: No. 6, 63-4(1961).

Properties of the perfusate from irradiated tissues were studied. Irradiation and perfusion with a Ringer-Locke solution of an isolated ear of a rabbit was carried out. The perfusate was collected during irradiation and during the next 25 min, following which it was injected intravenously into intact rabbits. Within 3 to 5 days, the relative number of lymphocytes decreased from 60 to 45%, while the absolute number was reduced by 20 to 30%. The blood coagulation time lengthened from 36 ± 1.36 to 68.2 ± 2.86 sec. The number of thrombocytes was reduced by 20 to 25%. Heating the perfusate to 57°C eliminated its ability to induce blood coagulation changes in the recipient animals. Boiling at 100° for 3 min produced complete inactivation of the perfusate. The absence of specific blood changes in dogs following injection of a perfusate from irradiated rabbit tissues indicated that the toxic substances in the perfusate possess type specificity. (M.C.G.)

17447 MORPHOLOGY AND HISTOLOGY OF TUMOR TYPES INDUCED BY X, GAMMA, AND BETA IRRADIATION OF A TOBACCO HYBRID. George L. Hagen, James E. Gunckel, and Arnold H. Sparrow (Rutgers Univ., New Brunswick, N. J. and Brookhaven National Lab., Upton, N. Y.). Am. J. Botany, 48: 691-9(Sept. 1961). (BNL-5338)

Radiation-induced tumors of an interspecific hybrid, Nicotiana glauca × N. langsdorffii, were of 6 morphological types: white-smooth; green-smooth; green-tomentose; purple-pigmented; green-leafy and stalked, although all intergrades could be found in 1 tomor mass. The morphological responses were essentially the same after treatment with acute x rays, chronic gamma or beta rays. Gamma rays were from an external cobalt-60 source and beta rays from internally deposited P^{32}. The histology of the 6 morphological tumor types was not distinctive in terms of meristem, vascular, and surface development, but rather followed an ontogenetic series from non-organoid to organoid. The results are discussed in terms of abnormal genome and physiological imbalances, and are compared to similar responses from infection with crown gall and wound-tumor virus. (auth)

17448 EARLY EFFECTS OF X-IRRADIATION ON CARTILAGE AND BONE. P. L. Melanotte and R. H. Follis, Jr. (Armed Forces Inst. of Pathology, Washington, D. C.). Am. J. Pathol., 39: 1-15(July 1961).

A study was made of the epiphysial cartilage and osteoblasts of the tibia in rats having a single exposure of x irradiation of increasing intensities from 400 to 1800 r administered from 1 to 10 days before sacrifice. Prompt damage to the cartilage was evidenced by cessation of growth and alterations in certain histochemical reactions. In contrast, stimulation of osteoblastic activity, i.e., proliferation with excessive matrix production, was found. (auth)

17449 THE EFFECT OF X-RADIATION ON THE FORMATION OF 5'DEOXYCYTIDYLIC ACID DEAMINASE IN REGENERATING LIVER. L. Stevens and L. A. Stocken (Oxford Univ.). Biochem. Biophys. Research Communs., 7: 315-17(May 4, 1962).

A dose of 500 r whole-body x radiation at 5 hr post-hepatectomy delayed the formation of 5'-deoxycytidylic acid deaminase in regenerating liver in rats. Data are tabulated. It is postulated that the effects of x radiation on thymidylate kinase are indirect. (C.H.)

17450 EFFECT OF X-RAYS ON OXIDATIVE PHOSPHORYLATION IN PLANT MITOCHONDRIA. N. M. Sisakyan and V. Ya. Kalacheva (Bakh Inst. of Biochemistry, Academy of Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 756-9(Mar.-Apr. 1962).

Far-reaching inhibition of oxidative phosphorylation in pea seedling mitochondria is detectable immediately after in vitro irradiation of whole plants at a dose level of 3 kilorads. Esterification of inorganic phosphorus is inhibited more strongly than oxygen absorption. The oxidative phosphorylation system in intact cells is more prone to radiation damage than that in isolated mitochondria. (auth)

17451 ELECTRON MICROSCOPY OF UNIRRADIATED AND IRRADIATED DEOXYRIBONUCLEIC ACID. N. A. Kiselev and N. V. Nikolaeva (Inst. of Crystallography and Inst. of Chemical Physics, Academy of Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 820-6 (Mar.-Apr. 1962).

An electron microscopic study was made of DNA from rat liver and spleen. As a result of the study of unirradiated DNA microphotographs were obtained of long molecules with a thickness of about 20 A and a stretching of these molecules. For one of the preparations, besides the molecules mentioned, a lump and fine fibers similar in thickness to the thickness of a single despiraled polynucleotide chain were found. For the study of the action of irradiation, preparations with the least signs of denaturation and degradation of the molecules were used. Preparations irradiated with doses of 60,000, 150,000, and 330,000 r showed the possibility of recording radiation changes using electron microscopy. In the irradiated preparations the effect of shortening (degradation) the molecules while retaining the two-fiber structure was observed, and also the formation of lumps (denaturation). With lower doses of irradiation the first event was a decreased denaturation effect. (auth)

17452 RIBONUCLEIC ACID METABOLISM DURING GROWTH OF EXCISED ROOT TIPS FROM NORMAL AND X-IRRADIATED CORN SEEDS. Joe H. Cherry (Univ. of Illinois, Urbana). Biochim. et Biophys Acta, 55: 487-94 (Apr. 2, 1962). (In English)

Growth of excised corn root tips was found to involve a degradation and loss of protein and ribonucleic acid. During growth (mostly cell elongation) of the normal excised root tips there is a major redistribution of ribonucleic acid among the subcellular components. The microsomal and

soluble ribonucleic acids rapidly decline with a concomitant increase in the nuclear and mitochondrial fractions. There was little redistribution of ribonucleic acid in the root tips from x-irradiated seeds, since the transformation had already occurred as a result of x irradiation prior to incubation of the root tips. Incorporation of uracil into the subcellular ribonucleic acid fractions by excised root tips revealed that the greatest incorporation was in the nuclei, followed in order by mitochondria, microsomes, and the soluble fraction. X irradiation greatly enhanced the incorporation of uracil into ribonucleic acid. Growth of root tips from normal and x irradiated seeds increased the ribonuclease activity as much as 2 to 4-fold. Root tips grown from x-irradiated seed had an initial ribonuclease activity 2 to 3-fold greater than normal tissue. (auth)

17453 THE RELATION OF RADIATION DOSE TO RADIATION DAMAGE IN THE TIBIA OF WEANLING RABBITS INJECTED WITH STRONTIUM 90. Sheila Macpherson, Maureen Owen, and Janet Vaughan (Churchill Hospital, Oxford). Brit. J. Radiol., 35: 221-34 (Apr. 1962).

A comparison of radiation damage and radiation dose in the proximal half of the tibia of weanling rabbits following a single injection of Sr^{90} at two dose levels, 100 and 600 μc/kg, was made in animals killed at various time intervals up to six months later. An attempt was made to quantitate the histological changes observed. Relatively little damage was seen at the lower dose level. At the higher dose level there was gross damage. The earliest damage was to the cells in the region of maximum proliferation immediately beneath the epiphyseal plate, within one day of injection. Disturbance of the blood vessels and epiphyseal cartilage plate was first observed at three days. Areas of abnormal cellular proliferation, presumed to be presarcomatous lesions, were seen in osteogenic connective tissue at three months, in regions which had received an accumulated dose of about 10,000 rads. Small discrete early tumors were sometimes noted in a region which had accumulated a similar dose. Multiple frank osteosarcomas had developed by six months. The lack of quantitative methods in histology is emphasized, and the difficulties involved in determining the carcinogenic radiation dose are discussed. (auth)

17454 THE EFFECT OF LOCALISED RADIATION ON AUTOLOGOUS SKIN TRANSPLANTS. Milton Elkin, Daniele Salvioni, and Marvin Binstock (Albert Einstein Coll. of Medicine, Yeshiva Univ., New York). Brit. J. Radiol., 35: 235-40 (Apr. 1962).

Localized irradiation in large enough dosage prejudices successful autologous skin transplantation in the rabbit. It appears that the deleterious effects of irradiation in this respect are first manifested in the graft itself; at higher doses, damage to the recipient site prevents takes. At the qualities of irradiation used in these experiments (HVL 0.31 mm of Al and 2.2 mm of Al), 2200 r to the donor skin prevented successful grafting whereas this dose to the recipient site showed no significant diminution in percentage of graft takes as compared to control levels. Administration of cysteine intravenously just before irradiation afforded partial protection to the donor skin. (auth)

17455 ACUTE PARAMYELOBLASTIC LEUKAEMIA FOLLOWING X-RAY THERAPY. D. G. Zographov (Postgraduate Medical School, Sofia). Brit. J. Radiol., 35: 285-7 (Apr. 1962).

The case history is presented of a case of acute paramyeloblastic leukemia that developed 3 years after x-ray therapy of breast cancer. (C.H.)

17456 ADAPTATION OF THE RAT INTESTINE TO CONTINUOUS IRRADIATION. N. F. Kember, H. Quastler, and D. R. Wimber (Brookhaven National Lab., Upton, N. Y. and Royal Cancer Hospital, London). Brit. J. Radiol., 35: 290 (Apr. 1962).

Cytophotometric methods were used to test the hypothesis that an increase in the amount of DNA per cell might account for the adaptation of rat intestinal epithelium to continuous irradiation. Histograms are presented that show the result of measurements of DNA content in crypt cells. Results indicate that this hypothesis is not correct. (C.H.)

17457 RADIO-SENSITISERS IN RADIOTHERAPY. B. A. Bridges (Wantage Research Lab., Berks, Eng.). Brit. J. Radiol., 35: 290-1 (Apr. 1962).

Procedures are discussed for the mathematical analysis of the value of radiosensitizing agents in the radiotherapy of tumors where both aerobic and anaerobic cells are involved. (C.H.)

17458 BLOOD RADIATION DOSE AFTER ^{131}I THERAPY OF THYROTOXICOSIS. CALCULATIONS WITH REFERENCE TO LEUKAEMIA. M. Green, Monica Fisher, H. Miller, and G. M. Wilson (Univ. of Sheffield, Eng. and Sheffield National Centre for Radiotherapy, Eng.). Brit. Med. J., [II]: 210-15 (July 22, 1961).

A case of acute leukemia diagnosed 17 months after I^{131} therapy for thyrotoxicosis is reported. In an attempt to assess the relationship between I^{131} therapy and the subsequent development of leukemia the radiation dose to the blood after a single therapeutic dose of I^{131} was measured in 191 thyrotoxic patients. The mean irradiation to the blood was 8 rads per therapeutic dose. The irradiation dose to the blood is related to the amount of I^{131} administered and the fraction passing into the plasma as protein-bound I^{131}. A nomogram taking into account these two factors was constructed from the measurements made on the 191 patients, so that the irradiation dose to the blood can be estimated in other patients treated by I^{131} for thyrotoxicosis. The blood irradiation dose for complete treatment of the disease was estimated from the nomogram in 802 patients previously treated with I^{131}. The mean dose was 16.6 rads, but in some patients receiving multiple treatments it was much greater, ranging up to 160 rads. The bone-marrow dose is estimated as 80% of the blood dose. Consideration of these results suggests that the risk of leukemogenesis is slight and does not contraindicate I^{131} therapy of thyrotoxicosis. Nevertheless it is important to record all cases of leukemia occurring after I^{131} therapy so that the validity of these conclusions may be examined. (auth)

17459 THE BIOLOGICAL ACTION OF HIGH ENERGY RADIATION. G. A. Zvrunina, N. M. Karamzina, V. I. Fedorova, and B. I. Yanovskaya (Inst. of Working Hygiene and Occupational Diseases, Academy of Medical Sciences, USSR). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Translation), 52: 912-15 (Feb. 1962).

Rats and mice were exposed to 660-Mev protons for 2 to 5 min. The dose for rats was 525 to 585 rad and for mice about 600 rad. The animals were killed 3, 8, 15, 30, 45, 60, 90, and 120 days after exposure. Data are summarized on organ weights, anatomical changes, and changes in the total quantity and metabolic pattern of ascorbic acid in the spleen, testes, and bone marrow. Changes in ascorbic acid metabolism preceded all morbid anatomical changes. (C.H.)

17460 THE EFFECT OF ANTISERA AGAINST IRRADIATED MALIGNANT TISSUES ON THE GROWTH OF EX-

PERIMENTAL TUMORS IN IRRADIATED ANIMALS. REPORT II. EFFECT OF THE SERUM AGAINST IRRADIATED ASCITIC CELLS ON THE GROWTH OF SUBCUTANEOUS AND ASCITIC FORMS OF EHRLICH'S ADENOCARCINOMA IN MICE. I. N. Maiskii, G. V. Suvorova, and P. P. Filatov (Inst. of Experimental Biology, Moscow). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Translation), 52: 948-50(Feb. 1962).

Results are presented from studies on the effects of antisera, obtained by inoculation of irradiated rabbits, on the growth of subcutaneously injected Ehrlich's adenocarcinoma cells in irradiated and non-irradiated mice. Results are tabulated. Irradiated inoculated animals showed a marked reduction in tumors on the 8th day after inoculation. Sera against irradiated cells had no effect on the growth of Ehrlich tumor in non-irradiated animals. Immune reactions involved are discussed. (C.H.)

17461 THE EFFECT OF TRANSPLANTATION OF BONE MARROW OR LYMPHOCYTES ON THE RESISTANCE OF IRRADIATED ANIMALS TO DIPHTHERIA TOXIN. D. R. Kaulen (Gamaleya Inst. of Epidemiology and Microbiology, Moscow). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Translation), 52: 1004-7(Mar. 1962).

Two experiments were staged on guinea pigs to investigate the effect produced by transplantation of the cells of homologous bone marrow and lymph nodes, in order to restore the natural resistance of the animals to diphtheria toxin, reduced as a result of irradiation (200 r). Both immunized and nonimmunized guinea pigs served as donors of the cells. Bone marrow was administered intravenously in a dose of 90 to $100 \cdot 10^6$ cells, or lymphocytes $25 \cdot 10^6$ cells. As established, bone marrow cells raised the resistance of the animals to diphtheria toxin, reduced as a result of irradiation. The resistance index in the group of animals treated with immune bone marrow equals 0.87 and with the nonimmune one 0.69. In irradiated control animals it equalled 0.34, and the resistance index of the normal animals was accepted as 1.0. Transplantation of lymphatic cells proved ineffective. It was impossible to detect any antitoxin in the recipients' blood, i.e., the transplanted cells produced no detectable amounts of the toxin. (auth)

17462 THE EFFECT OF X-RAY IRRADIATION UPON THE FORMATION OF A SYMPATHETIC NERVOUS SYSTEM MEDIATOR. I. N. Volkova, K. V. Lebedev, and L. V. Tukhvatullina (Kazan Medical Inst.). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Translation), 52: 1013-15(Mar. 1962).

A study was made of the extent of sympathin (a sympathetic nervous system mediator) liberation into the fluid perfused through the frog cardiac cavity at the moment of sympathetic nerve excitation. Sympathin (adrenalin) was determined by the method of luminescent analysis. As established, the total x-ray irradiation of frogs in a dose of 4500 r disturbs the sympathin-forming process. On the 2nd to 4th day after irradiation the amount of the sympathin liberated was found to be below its normal level; it almost regained from the 5th to the 7th day, but on the 13th to 18th day experienced a new considerable drop. Only by the 30th day after irradiation there occurred a gradual normalization of the sympathin-forming process. (auth)

17463 THE EFFECT OF IONIZING RADIATION ON THE ANTIGENIC AND BIOLOGICAL PROPERTIES OF THE M-1 RAT TUMOR. I. N. Maiskii, G. V. Suvorova, and P. P. Filatov (Inst. of Experimental Biology, Moscow). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Translation), 52: 1065-7(Mar. 1962).

An inquiry was made into the effect of x rays on the antigenic and biological properties of the rat M-1 sarcoma. Anaphylactic reaction with desensitization brought evidence that irradiation of a tumor tissue with 5,000 r caused significant changes in its antigenic structure. The doses of 2,000, 10,000, and 20,000 r prolonged the latent period of tumor development following inoculation of irradiated cells. (auth)

17464 EFFECTS OF X IRRADIATION ON ENZYME SYNTHESIS DURING LIVER REGENERATION. D. K. Myers (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Biochem. and Physiol., 40: 619-30(May 1962). (AECL-1482)

Twenty-four different enzymes or enzyme systems were assayed in regenerating rat liver from control and irradiated animals at various times after partial hepatectomy. X irradiation, either of the whole liver region or of an exteriorized liver lobule, interfered with the accumulation of only three of these enzymes: deoxycytidylate deaminase, thymidine phosphorylase, and NAD pyrophosphorylase. Irradiation did not affect the synthesis of related enzymes such as adenosine and guanine deaminases, and inosine and uridine phosphorylases. The effects of irradiation on enzyme synthesis in regenerating liver would appear to be highly selective. (auth)

17465 RADIATION EPIDEMIOLOGY. Theodor D. Sterling, Eugene L. Saenger, and John J. Phair (Univ. of Cincinnati and Children's Hospital, Cincinnati). Cancer, 15: 489-503(May-June 1962).

Epidemiological methods have undergone constant changes as their use has extended from the study of infections to the study of other diseases. Presently the field of radiology appears to serve as a focus for reanalysis of epidemiological tools and concepts because, despite diligent applications of approved procedures, a number of epidemiological investigations have failed to answer questions on the possible hazards arising from relatively small radiation doses used in diagnoses and during some treatments. Formal framework of the epidemiological method with the help of set theoretical language is defined. Before satisfactory conclusions can be drawn, the sampling procedure has to lead to the postulation of at least 2 alternative hypotheses for statistical evaluation. In some instances, random sampling from an untreated population or the use of such a population as a control one would not enable the investigator to draw valid conclusions from observed disease rates. The criteria upon which the validity of experimental results can be judged are defined in terms of eligibility concepts. Suggestions are made for valid designs of investigations based on the concepts of eligibility and incorporating necessary controls for it. The literature in 3 areas of intense work is evaluated and discussed in relation to the formal analyses. Reasons for the failure of relevant studies to clarify the effects of small dose radiation are indicated. (auth)

17466 POSTIRRADIATION FIBROSARCOMA OF THE BRAIN. Max Noetzli and Nathan Malamud (Univ. of California School of Medicine, San Francisco). Cancer, 15: 617-22(May-June 1962).

A 10-year-old girl was treated with surgery and radiation therapy for a medulloblastoma that had remained controlled for 8 years. Then, a fibrosarcoma that proved fatal developed in previously irradiated brain tissue. No residual or recurrent medulloblastoma was found at autopsy. The pertinent literature is reviewed. (auth)

17467 THE EFFECT OF OXYGEN CONCENTRATION ON THE FREQUENCY OF INDUCED XO MALES AND NON-

DISJUNCTION FEMALES AFTER IRRADIATION OF DROSOPHILA MALES. Ruth Saevhagen (Univ. of Stockholm). Hereditas, 47: 163-89(1961). (In English)

Studies were made on the effect of irradiation under different oxygen concentrations during various stages of spermatogenesis. By use of a dual purpose stock it was possible to study the frequency of induced XO males and induced non-disjunction between the paternal X and Y chromosomes. Drosophila, 0-1 and 3-4 day old y^{1f} and $sc^{8}Y$ males, were irradiated in commercial nitrogen or oxygen and mated to virgin y w sn females. A comparison between the yield of XO males after irradiation under anaerobic conditions and the corresponding data after treatment in air shows that a significantly lower rate of induced XO males is obtained after irradiation in N_2 atmosphere. The difference is most marked in mating periods corresponding to the period of highest sensitivity. The effect of commercial oxygen on the frequency of induced XO males after irradiation of 0-1 and 3-4 day old males is reversed as compared to the effect of air atmosphere. For 3-4 day old males irradiation in O_2 increases the yield of XO males. For both types of males almost no enhancing effect is obtained for mature spermatozoa after irradiation in O_2. It is concluded that it is not possible to talk about a common air/nitrogen ratio of radiosensitivity for irradiated Drosophila males, since there exists great variations between the different mating periods. For 3-4 day old males, irradiation under anoxia gives an almost total protection against induced non-disjunction. For 0-1 day old males a reduction in the yield of non-disjunction females is observed, but still on the 8th day a rise in wild type females was observed. The relation between radiosensitivity and intra and/or intercellular oxygen available in the treated cells is discussed. (P.C.H.)

17468 THE RELATIONSHIP BETWEEN TYPE OF ABERRATION AND SENSITIVITY PATTERN IN IRRADIATED DROSOPHILA MELANOGASTER MALES. Ruth Saevhagen (Univ. of Stockholm). Hereditas, 47: 190-6(1961). (In English)

Differences between sensitivity patterns for various types of induced genetic damages were compared and found to reflect the relationship between the different mechanisms at work in producing damages and the cell stage treated. It was concluded that there exists not only a marked difference in sensitivity to irradiation between various stages of spermatogenesis in Drosophila, but also a difference in sensitivity according to which type of aberration is studied. It is also obvious that the changes in sensitivity are delimited to very short intervals during spermatogenesis. (P.C.H.)

17469 VIABLE MUTANTS INDUCED IN BARLEY BY IONIZING RADIATIONS AND CHEMICAL MUTAGENS. L. Ehrenberg, Å. Gustafsson, and U. Lundqvist. Hereditas, 47: 243-82(1961). (In English)

Genetic effects of ionizing radiations and chemical mutagens, especially with regard to the induction of viable mutants, were compared in barley. The chief mutagens used consisted of neutron and x irradiation, as well as treatments with glycidol, ethyleneimine, and ethyl methanesulfonate. Greenhouse mutants (chlorophyll mutants) amounted to 4000 cases in the years 1958–1960. Field aberrations consisted of 2400 chlorophyll mutants, 650 dwarfs and other lethals, 5200 cases of so-called translocation sterility, and more than 1000 cases of viable mutants. The total sum of X_2 aberrations, analyzed in the field, was 9300, in circa 21500 spike progenies. Neutrons and x rays generally produce rates of greenhouse mutations up to 8 or 10%, or under special experimental conditions up to 13 or 14%. Using ethyleneimine, rates of 25 to 30% are reached and with ethyl methanesulfonate, rates of 50 to 60%. The ratios of offspring showing translocation sterility to offspring with viable mutants are high applying neutrons and x rays, but low applying ethyleneimine and ethylmethanesulfonate. Ethyleneimine is especially efficient in inducing rare morphological mutants. In general, viable mutants are followed to the X_3 generation. Problems relating to the capacity of radiations and chemicals in causing specific gene mutations are briefly discussed. (P.C.H.)

17470 RADIATION SENSITIVITY OF PINE SEEDS OF DIFFERENT WATER CONTENT. Kihachiro Ohba (Forest Research Inst., Stockholm and Government Forest Experiment Station, Tokyo). Hereditas, 47: 283-94(1961). (In English)

Gamma radiosensitivity of Japanese red pine seeds with different water contents was studied. Only seeds of embryo class IV (mature embryo) originating from seven trees were used. Seven different doses and six different water contents were applied in combination. Doses were 0, 3, 6, 9, 12, 15, and 18×10^3 r. Seeds were brought to 16.3, 12.7, 8.8, 7.5, 6.1, and 2.2% water content by equilibration with air of varying humidity. As the indicators of radiosensitivity, the following criteria were applied: germination percentage, survival percentage, plant development, and stages of dead plants. According to the results, the minimum sensitivity was found in seeds with about 13% water content. Seeds with higher or lower water content were more sensitive. Irradiated seeds of higher or, especially, lower water content yielded very low germination percentages and high seedling mortality. For the purpose of securing X_1 plants of Japanese red pine, which show the influence of the irradiation, it seems profitable to bring seeds to a water content of about 13% and to irradiate them with doses of 9000–12000 r. (auth)

17471 UNEQUAL CROSSING-OVER IN THE BAR REGION OF DROSOPHILA MELANOGASTER. II. INFLUENCE OF TEMPERATURE, X-RAYS AND EDTA. Marianne Rasmuson (Univ. of Uppsala). Hereditas, 47: 357-78 (1961). (In English)

Unequal crossing-over in the Bar segment of Drosophila Melanogaster, giving rise to reverted B^+ and BB, was used in a study of induced crossing-over to reveal the possible presence of clusters. The following enhancing treatments were used: high temperature, 31°C for 48 hours; x rays in two doses, 4000 and 2500 r; and EDTA, a chelating agent known to deprive the organisms of calcium. Frequency of crossing-over in the region f–car was registered and compared to the frequency of unequal crossing-over in the Bar segment. The two aspects of crossing-over mostly behaved in the same way in their response to the treatments. High temperature and the higher x-ray dose were found to be effective in raising the frequency of crossovers. The lower x-ray dose was without effect and EDTA treatment was dubious but seemed to enhance the frequency to a small extent in the later broods. The material was tested for the presence of clusters of unequal crossovers by making comparisons with the Poisson distribution and with the expected frequencies of different kinds of cross overs assuming independent origin. Their distribution on successive broods was also considered. The joint result of the tests was negative. Since a significant increase in crossing-over frequency was observed without the simultaneous presence of clusters, it is inferred that induction of gonial crossing-over with subsequent multiplication of the crossover products is not the cause of the enhancing effect of the treatments. It was supposed that the influence on meiotic

crossing-over is indirect, since the exchange was supposed to occur in late pachytene. A recent hypothesis, however, places the crossing-over event at the time of DNA duplication in pre-leptotene, and it is suggested that, this being the case, the effect of the enhancing treatment can be direct on the crossing-over process that takes place at this early stage. (auth)

17472 RADIOSENSITIVITY AND BIOLOGICAL PROPERTIES OF TWO TUMOUR-TYPES INDIGENOUS TO THE SAME HOST. IV. EFFECT OF SINGLE AND MULTIPLE X-RAY TREATMENTS ON TUMOUR REGRESSION. Anna Goldfeder (Department of Hospitals, New York and New York Univ., New York). Intern. J. Radiation Biol., 4: 537-54(Feb. 1962). (In English)

A study was undertaken to provide information regarding the comparative effects of single and divided x-ray doses on the regression of experimental tumors. Two types of mammary tumors, a slower-growing, epithelial-cell type designated DBAH, and a faster-growing, spindle-cell type designated DBAG, both indigenous to the inbred DBA/212 strain of mice and propagated in parent hosts, were x-irradiated in vivo. A total dose of 10,000 r was employed in one exposure and in 2, 4, and 8 equal fractions delivered at 24-hr intervals to tumors ranging in size from 12 to 15 mm in diameter. The greatest effect on both types of tumors was obtained when 10,000 r was employed in two equal doses and the least effect when the dose was divided into eight equal fractions. Instances of local recurrences and distant metastases were more frequent in mice with the DBAG tumor treated with fractionated doses than in mice with the DBAH tumor. Quantitative data are recorded in tables. A contrasting pattern of cellular response to x irradiation of these two types of tumor is demonstrated in the microphotographs. (auth)

17473 EFFECTS OF IRRADIATION WITH LOW-ENERGY X-RAYS ON RESTING- AND ACTION-POTENTIALS OF SKELETAL- AND HEART-MUSCLE FIBRES. P. Heistracher, B. Pillat, and O. Kraupp (Universität, Vienna). Intern. J. Radiation Biol., 4: 555-66(Feb. 1962). (In English)

The effects of x irradiation (50 kv) on resting- and action-potentials of isolated frog sartorius muscles, of heart-muscle fibers (papillary muscles of cats and Purkinje fibers of calves and sheep) were investigated by the intracellular recording technique. On frog sartorius fibers, radiation doses below 160 kr had no effect on the resting-potential; higher doses led to a dose-dependent decrease of about 1 mv per 160 kr. This effect was independent of the dose-rate in a range from 3 up to 85 kr/min. Shape and amplitude of the action-potential of frog sartorius fibers (stimulus frequency: 0.2/min) were not influenced significantly by irradiation of 15 min duration up to doses of 600 kr. On rhythmically-stimulated (85/min), isolated papillary muscles, irradiation with total doses up to 240 kr had no effect on the resting- and action-potential. Higher doses (345 to 440 kr) produced a significant fall in the resting-potential, action-potential, and rate of rise, as well as a shortening of repolarization-time and a decrease in mechanical tension. These changes were most marked immediately after irradiation and were partly reversible within one hr. Spontaneously-beating Purkinje fibers were at least 10 to 15 times more sensitive to x rays than papillary muscles. As in papillary muscle, irradiation caused a decrease in the maximal diastolic potential, the action-potential, and the upstroke velocity, the latter effect being most pronounced. At the same time, some decrease in slow diastolic depolarization and frequency was observed. All these changes were reversible within 30 min. The observed effects point to a partial inactivation of the sodium-carrying system as a possible primary mechanism of action. (auth)

17474 PROTECTIVE ACTION OF 2,4-DINITROPHENOL AGAINST X-RADIATION INJURY. RADIOPROTECTIVE EFFECT OF 2,4-DINITROPHENOL. M. Prasilička, M. Hill, and L. Novák (Šafarik Univ., Košice, Czechoslovakia and Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Intern. J. Radiation Biol., 4: 567-79(Feb. 1962). (In English)

The authors studied the problem of the effect of 2,4-dinitrophenol administered prior to and after irradiation on the development of post-irradiation injury in mice. Estimations revealed that the respiratory metabolism in mice during irradiation was increased after dinitrophenol by 70 to 80% above rest values before the administration of dinitrophenol, and by as much as 200% above values during sleep in controls. Mice irradiated under these conditions were protected against radiation, as indicated by a highly-significant increase in the number of surviving animals, by a smaller reduction in the number of leucocytes, their more rapid increase in the reparative stage and an earlier onset of regeneration of lymphatic nodules and hemopoietic tissue of the spleen. (auth)

17475 THE RADIOSENSITIVITY OF GERM-CELLS AT VARIOUS STAGES OF OVARIAN DEVELOPMENT. Heather M. Beaumont (Univ. of Birmingham, Eng.). Intern. J. Radiation Biol., 4: 581-90(Feb. 1962). (In English)

Female rats were exposed to 50 and 100 r x rays on the 8th, 10th, and 12th days of intra-uterine life, at birth, and on the 2nd and 5th days after birth. As judged by the survival of oocytes at the age of 25 days, germ-cells in the developing ovary undergo two periods of high radiosensitivity: the first at 15 days post coitum, when oogonial mitoses are frequent, and the second shortly after birth, when the oocytes attain the dictyate phase. The intervening period of relative refractoriness to radiation damage occurs while the oocytes undergo the prophase of meiosis. (auth)

17476 STUDIES ON THE METABOLISM OF TISSUE PROTEINS. II. INFLUENCE OF X-IRRADIATION AND STARVATION ON THE METABOLISM OF COLLAGEN. G. B. Gerber, G. Gerber, K. I. Altman, and L. H. Hempelmann (Univ. of Rochester, N. Y.). Intern. J. Radiation Biol., 4: 609-14(Feb. 1962). (In English)

Rats were injected with proline-U-C^{14} and exposed to total-body x irradiation at various time-intervals thereafter. Proline and hydroxyproline were isolated from collagen of various organs as well as from sub-fractions of skin collagen and their specific activity determined. From the changes in specific activity of proline and hydroxyproline observed after exposure it is postulated that more metabolically-active collagen is degraded and that the conversion of soluble to insoluble collagen is partially inhibited after irradiation. (auth)

17477 STUDIES ON THE METABOLISM OF TISSUE PROTEINS. III. THE TURNOVER OF SOLUBLE PROTEINS AND ELASTIN LABELLED WITH ^{14}C PROLINE AND ITS RELATION TO EXPOSURE TO TOTAL-BODY X-IRRADIATION. G. B. Gerber, G. Gerber, K. I. Altman, and L. H. Hempelmann (Univ. of Rochester, N. Y.). Intern. J. Radiation Biol., 4: 615-21(Feb. 1962). (In English)

Rats were injected with proline-U-C^{14} and exposed to total-body x-irradiation at various time-intervals there-

after. Proline was isolated from the soluble protein and elastin fractions of various organs and its specific activity determined. In most organs an increase in specific activity of proline of these two protein fractions was observed after irradiation. This was interpreted to mean either a lowered metabolic replacement or a loss of certain components from these protein fractions after irradiation. It is suggested that the decrease in specific activity observed in the spleen is correlated to changes in the cell-population in this organ after irradiation. (auth)

17478 INFLUENCE OF HIGH DOSES OF X-RADIATION ON 5-HYDROXYTRYPTAMINE IN THE BRAIN OF RATS. M. Randic and Z. Supek (Institute 'Rudjer Bosković', Zagreb). Intern. J. Radiation Biol., 4: 637-8(Feb. 1962). (In English)

Doses of 8,000 and 12,000 r significantly increased the 5-hydroxytryptamine (5-HT) content of the brains of rats. Doses of 4,000 r did not elicit any change in 5-HT content. The effects of 5-HT on the function of the central nervous system and the mechanism of the increase of 5-HT after large doses of radiation are reported under investigation. (C.H.)

17479 DIFFERENTIAL SENSITIVITY TO GAMMA IRRADIATION OF LILIUM VARIETIES. Guru D. Pershad and C. C. Bowen (Iowa State Univ., Ames). J. Heredity, 52: 67-72(Mar.-Apr. 1961).

Sporocytes of eight different forms of Lilium, including four horticultural varieties of L. longiflorum, at known stages of meiotic prophase were subjected to Co^{60} gamma irradiation. Cytological aberrations were scored at anaphase I. Variations in sensitivity between the several varieties and species irradiated indicated that closely related forms had similar sensitivities and that more distant relationships were accompanied by differences in net reaction. Hybrids between distant species tended to be more sensitive and showed greater variation than the relatively homozygous and highly inbred pure species. (auth)

17480 GENETICS OF X-RAY INDUCED PIGMENTATION IN JUTE. M. S. Sarma and K. Ghosh (Jute Agricultural Research Inst., Barrackpore, India). J. Heredity, 52: 83-8(Mar.-Apr. 1961).

A full-green strain of Corchorus capsularis having the constitution ccAARR for the anthocyanin factors was treated with x rays. In the X_2 generation of a bifurcated but otherwise normal looking selection from the 45 Kvp, 40,000 r treatment, a pigmented type was obtained as a recessive segregant. The pigmented mutant is indistinguishable from full-green in the early stages; at later stages the stem is dark-coppery-red and the integuments of ovules are pink even at the flowering stage. Although the embryos of seeds of the mutant are normal, the endosperm is imperfectly developed; this results in extremely poor germination. Crosses of the pigmented mutant with cAR, CAR and CA^Dr showed one, two, and four factor differences, respectively. On the basis of this evidence, it is concluded that the induced change is at a newly identified locus, Pi, and is recessive to the normal state; the action of pi is dependent on the presence of two doses of R; pi is epistatic over C; Pi or at least one dose of r is essential for the normal functioning of C; and in the absence of C-controlled anthocyamin, A and A^D, the two alleles of A tested, have no recognizable action. (auth)

17481 EFFECT OF X-IRRADIATION ON THE GROWTH AND MORPHOLOGY OF EHRLICH'S ASCITES CARCINOMA CELLS. H. Tanaka (Keio Univ., Tokyo). Keio Igaku, 37: 1421(1960).

The minimal x-ray dose to cause complete inhibition of transplantability was found to be 3500 r. The 50% transplantability dose was 1500 r in the ascites type of carcinoma. The tumor cells were edematous enlarged after irradiation with the small dose. When the large dose was given, reduction of cell size, degeneration, and vacuolization were found. The endoplasmic reticulum was destroyed after even the small dose of irradiation. (Abstr. Japan Med., 2: No. 3, March 1962)

17482 EFFECTS OF X-RAYS ON THE AGEING OF SEEDS. Karl Sax and Haily J. Sax (Oxford Univ.). Nature, 194: 459-60(May 5, 1962).

Onion seeds were exposed to 1000 r x irradiation and stored in an oven at 42°C to hasten the aging process. Artificial aging did not increase the aberration frequency during the first three weeks, but with subsequent aging the aberration frequency increased rapidly and at an accelerated rate in the control seeds. The aberration frequency in the irradiated seeds seemed to increase earlier with aging, but not so much as would be expected if the irradiation had simply aged the seeds to the level that the controls had reached after about six weeks of aging. Tests also showed that delay in germination was associated with an increasing aberration frequency. However, seed germination showed little correlation with the frequency of chromosome aberrations. A second experiment was done with older onion seeds. Although the results were similar, there was, however, no lag-time in the increase of aberrations with aging. The results seem to support the conclusion that chromosome aberrations are the result, not the cause, of aging. (P.C.H.)

17483 INFLUENCE OF X-RAYS ON INFECTION WITH CANDIDA ALBICANS IN MICE. M. Machida (Nihon Univ. School of Medicine, Tokyo). Nichidai Igaku Zasshi, 19: Suppl., 1638(1960).

Various doses of whole-body x irradiation were given to mice, followed by the inoculation of Candida albicans. When a small dose of radiation was given the survival rate was about the same as in the control group. If, however, a large amount of Candida albicans was inoculated, the mortality rate was definitely higher in the irradiation group. (Abstr. Japan Med., 2: No. 3, March 1962)

17484 THE EFFECTS OF ADENINE ON LEUCOPENIA DUE TO X-IRRADIATION. H. Irie, K. Matsuura, H. Yoshida, K. Mori, and H. Nakamura (Kyushu Univ., Fukuoka). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2611-19(1961).

Adenine (6-aminopurine) was administered to 30 patients with malignant tumors in whom leukopenia had been induced by radiotherapy. Of the 14 patients treated with i.v. adenine (30–60 mg daily) 72% showed good results, of the 9 patients who received i.m. injections of 20 mg per day plus oral administration, 67% showed good results, and of the 7 patients treated with 60 mg per day orally, 57% showed a good response. (Abstr. Japan Med., 2: No. 3, March 1962)

17485 EFFECT OF GAMMA-IRRADIATION IN VITRO ON THE CYTOPLASMIC PARTICULATES OF MOUSE LIVER. I. MITOCHONDRIA. K. Hori and Y. Fujino (Univ. Medical School, Osaka). Nippon Igaku Hoshasen Gakkai Zasshi, 21: No. 3, 213-17(1961).

Disturbances of respiratory enzyme systems in mitochondria occur in the early stage of γ irradiation. Uncoupling of oxidative phosphorylation seems to be slightly delayed, and oxidation is relatively suppressed. Pyridine nucleotide is slightly decreased. The increase of ATPase

activity in mitochondria is slight and appears at a rather late stage. (Abstr. Japan Med., 2: No. 3, March 1962)

17486 STUDY OF VARIOUS CELLULAR TYPES AND OF MITOTIC CURVES FOUND DURING THE ENTIRE DEVELOPMENT OF EHRLICH CARCINOMA IN THE ASCITE FORM EITHER IN IRRADIATED OR IN NONIRRADIATED ANIMALS. M. Caprotti (Universität, Zurich and Università, Pavia). Oncologia, 15: No. 1, 27-43(1962). (In Italian)

The various cell types and the mitotic curves of the Ehrlich carcinoma of the ascitic type were investigated during the entire tumor development in irradiated and non-irradiated implanted mice. The various cell types (small, medium, and polynuclear giant cells), their percentage variations, and their mitotic curves are studied, and their significance is discussed in detail. (auth)

17487 THE SURVIVAL OF HOMOLOGOUS AND HETEROLOGOUS RED BLOOD CORPUSCLES IN IRRADIATED ANIMALS. H. Hio-Hi, A. Dunjic, and H. Maisin (Université, Louvain, Belg.). Pathol. et biol., Semaine hôp., (N. S.), 8: 1607-14([Sept.]1960). (In French)

The survival of homologous and heterologous red blood corpuscles marked with radioactive chromium was studied in irradiated and non-irradiated rats and mice. As a rule, in irradiated animals, the apparent survival of red blood corpuscles is reduced. The causes of this decrease are indirect and due to the irradiation of the host in whom there occur: a temporary cessation of erythropoiesis, hemorrhage, and increase of vascular permeability. The host's immunological response to the transferred homologous red blood corpuscles may be modified by irradiation. In that case, the survival of the homologous cells is improved in comparison to the survival in a non-irradiated subject. The immunological incompatibility toward the heterologous red blood corpuscles is not modified by irradiation except in cases where rat's red blood corpuscles are transferred to mice. The results concerning the survival of homologous and heterologous red blood corpuscles are discussed in relation to the results concerning the success in transplanting homologous and heterologous bone marrow after irradiation. (auth)

17488 GAMMA-RAY SENSITIVITY OF OOCYTES OF IMMATURE MICE. E. F. Oakberg (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med., 109: 763-7 (Apr. 1962).

Sensitivity of oocytes of 10-day-old mice to radiation-induced cell death was estimated by counting surviving cells 72 hr after Co^{60} gamma-ray exposures of 0, 1, 3, 5, 7, 10, 15, and 25 r. An LD_{50} of 8.4 r, with 95% confidence limits of 7.2 and 9.7 r has been estimated for stage 1, and an LD_{50} of 9.4 r, 95% confidence limits of 6.7 and 14.9 r, was obtained for stage 2 oocytes. Acute irradiation was more effective than chronic exposure in both young and adult females. After chronic exposure, survival is higher in the adult than for equivalent oocyte stages of young mice. This could result either from higher radiation sensitivity of oocytes of 7 to 14-day-old females, or from more efficient repair mechanisms in adult females. Oocytes in later stages of follicular development appeared to be more resistant in both immature and adult females. This result is in agreement with the fertility pattern of irradiated female mice and indicates highest resistance for more mature follicle stages. These data are discussed in relation to changes in fertility response of the mouse at different fetal and early postnatal oocyte stages. The possibility that radiation might have extremely severe effects on the ovary at particularly sensitive periods of development in other species is emphasized. (auth)

17489 EFFECTS OF OXYGEN ON THE INACTIVATION OF ENZYMES BY IONIZING RADIATIONS. I. DILUTE SOLUTIONS OF TRYPSIN AND DEOXYRIBONUCLEASE. A. B. Robins and J. A. V. Butler (Royal Cancer Hospital, London). Radiation Research, 16, 7-17(Jan. 1962).

The inactivation of trypsin was studied in dilute solutions in the presence and absence of oxygen, over a range of pH and in the presence of various anions. Between pH 1 and 6 in chloride and sulfate solutions oxygen increases D_{37}, the effect being greatest between pH 3 and 4. Its effect in nitrate solutions is comparatively small. These effects are ascribed to a chain reaction involving O_2^- or O_2H and a radical derived from the anion, which facilitates radical recombination. At pH > 6 the results are rather erratic, owing to the ease with which the enzyme is autodigested, but there appears to be a small positive oxygen effect. A few experiments were also made on the protective effects of cystein, and it was found that the degree of protection was much less in air than in vacuo. (auth)

17490 EFFECT OF DIFFERENT OXYGEN TENSIONS ON CHROMOSOME BREAKAGE INDUCED BY X-RAYS IN THE EHRLICH ASCITES TUMOR. Juan I. Valencia (Universidad, Buenos Aires) and Carmen Bertucci de Lozzio. Radiation Research, 16: 18-26(Jan. 1962).

A study was made of the nature and frequency of chromosomal aberrations induced by 2000 r of x rays in the cells of the Ehrlich ascites tumor, subline ELD, under different oxygen tensions. The number of breaks per cell did not vary significantly at the different oxygen tensions studied; the number of fragments was 4.4 times as high as at high oxygen tensions; and the chromatid exchanges were 4.5 as high in anoxia. These data are considered to be indicative that high oxygen tensions produce a permanent inactivation of the rejoining system. Since the aberrations observed in anoxia were predominantly of the chromatid type, whereas those induced in oxygen were of the chromosome type, it is also suggested that oxygen or anoxia could modify the predominant stage of mitosis of a cell population when the dose and treatment are administered, as in this case, over a long period of time. (auth)

17491 THE EFFECTS OF WHOLE-BODY X-IRRADIATION ON THE ACTIVITY OF SOME ACID HYDROLASES IN HOMOGENATES AND SUBCELLULAR FRACTIONS OF RAT SPLEEN. Jay S. Roth, Josef Bukovsky, and Herbert J. Eichel (Univ. of Connecticut, Storrs and Hahnemann Medical Coll., Philadelphia). Radiation Research, 16: 27-36(Jan. 1962).

The specific activity and distribution of β-glucuronidase, acid phosphatase, and phosphoprotein phosphatase in subcellular fractions of rat spleen were determined in control rats and in rats given 700 r of whole-body x irradiation. In control animals, on separation of subcellular fractions, the three enzymes were concentrated only in the supernatant fraction, in distinction to the distribution of these enzymes in liver, where the enzymes are concentrated in the mitochondrial fraction. Irradiation with 700 r caused only small changes in the distribution of β-glucuronidase and acid phosphatase. There was a modest increase in the amount of enzyme in the supernatant fraction and a small decline in the nuclear and mitochondrial fractions. No significant change was observed in the distribution of phosphoprotein phosphatase. Specific activities of β-glucuronidase and acid phosphatase increased at 16 hours postirradiation, and by 64 hours they had approximately doubled. This increase was interpreted as being caused by selective retention of enzyme during loss of spleen nitrogen. Results are discussed in relation to the behavior of lysosomal enzymes

and compared to a previous similar study on ribonuclease specific activity and distribution in the spleens of irradiated rats. (auth)

17492 EFFECT OF IONIZING RADIATION ON 9, 10-DIMETHYL-1,2-BENZANTHRACENE TUMORIGENESIS. Mary F. Argus, Judith F. Kane, M. Sakuntala, and F. E. Ray (Univ. of Florida, Gainesville). Radiation Research, 16: 37-43(Jan. 1962).

9,10-Dimethyl-1,2-benzanthracene (DMBA) was applied to the skin of female Swiss albino mice in the following amounts: 0.00002, 0.12, 0.20, 0.40, 0.80, and 1.60 mg. The lowest dose produced no skin papillomas; 0.12 mg resulted in one tumor appearing at 34 weeks; there was an increase in the tumor incidence from this dosage up to the 0.80 mg dose level. Exposure of the mouse skin to 200, 400, or 600 r of γ irradiation from a cobalt-60 source, or 800, 1600, or 3200 r of x irradiation failed to produce skin tumors. No enhancement of skin tumorigenic action was found when 200 r of γ irradiation was applied concurrently with 0.12 mg of DMBA, or when 200, 400, or 600 r of γ irradiation was applied concurrently with 0.00002 mg of DMBA. X irradiation with 1600 and 3200 r was found to inhibit the tumorigenic activity of 0.20 mg of DMBA when applied either after or prior to the chemical. With a dosage level of 0.80 mg of DMBA, however, these levels of x irradiation exhibited no inhibition. (auth)

17493 PERSISTENT CHROMOSOME ABERRATIONS IN IRRADIATED HUMAN SUBJECTS. M. A. Bender and P. C. Gooch (Oak Ridge National Lab., Tenn.). Radiation Research, 16: 44-53(Jan. 1962).

Chromosomes of a number of men exposed to whole-body mixed γ and fission neutron irradiation, as well as those of five unirradiated control individuals, were examined. Cytological preparations were made from short-term cultures of peripheral blood leukocytes approximately 29 months after the irradiation occurred. The doses were estimated to range from 22.8 to 365 rads. Five men received doses estimated to exceed 230 rads; three others received lower doses. In the five control individuals no major chromosomal abnormalities were found, other than the expected low frequencies of chromatid-type aberrations and counts other than 2n = 46. In cells from the irradiated individuals, however, changes in both chromosome number and form were observed. In the five high-dose cases, the frequency of cells with counts of other than 2n = 46 ranged from 7 to 23%. Grossly altered chromosomes, such as rings, dicentrics, and minutes, were found, often in cells with abnormal counts, with a frequency ranging from 2 to 20 per 100 cells. Two of the three low-dose individuals also show variations in number and form of their chromosomes, but at a much lower frequency than the high-dose cases. (auth)

17494 LATE EFFECTS OF TOTAL-BODY X-IRRADIATION. VI. INCREASED SUSCEPTIBILITY OF IRRADIATED RATS TO ORAL HYPERTONIC SODIUM CHLORIDE. Baldwin G. Lamson, Daniel A. Lang, Marta S. Billings, J. J. Gambino, and Leslie R. Bennett (Univ. of California, Los Angeles). Radiation Research, 16: 54-65(Jan. 1962).

Chronic salt loading of female Wistar rats was produced by a gradual restriction of fluid intake to 2% NaCl. As judged by rate of loss of body weight and mean survival young mature rats were less affected than older rats. During a 2-month period of salt loading, 13 to 30% of the control rats died. Survivors of a single exposure to 1000 r of hypoxic whole-body x irradiation were tested by chronic salt loading 2 to 9 months later. Loss of weight was more rapid than in the controls, and all the rats died within 2 months. In both controls and irradiated rats on a salt-loading regime, death was preceded by very high levels of serum Na, up to 200 meq/l. Although one-third of irradiated rats dying spontaneously in old age showed typical nephrosclerosis, morphologic renal disease was infrequent in both irradiated and control rats dying while on chronic salt load. (auth)

17495 THE EFFECT OF BEAM DIRECTION AND BACKSCATTERED RADIATION ON ACUTE MORTALITY IN X-IRRADIATED FEMALE CBA MICE. M. J. Corp and R. H. Mole (Medical Research Council, Harwell, Berks, Eng.). Radiation Research, 16: 66-75(Jan. 1962).

When a primary x-ray beam with the minimum of backscatter was used, the $LD_{50(30)}$ for whole-body irradiation of mice was found to be 11% less when the beam entered the dorsal surface of the animals than when it entered the ventral surface. When full backscatter was added to the primary beam this difference was reduced, as would be expected. Differences in degree of scatter and in beam direction therefore seem likely to account for only a small part of the differences in the $LD_{50/30}$ for mice given whole-body x irradiation in different laboratories. (auth)

17496 FAST NEUTRON IRRADIATION AND THE RELATIONSHIP OF RADIATION DOSE AND MAMMALIAN TUMOR CELL REPRODUCTIVE CAPACITY. J. Robert Andrews and Roger J. Berry (National Cancer Inst., Bethesda, Md.). Radiation Research, 16: 76-81(Jan. 1962).

The dose-response relationship for neutron irradiation of a quantitative in vivo mouse tumor cell system was determined and compared with the dose-response relationship for x irradiation performed under both anoxic and oxygenated conditions. Values of n = 1.0 and D_{37} = 85 rads were obtained for fission-spectrum fast neutron irradiation as compared with n = 1.6 and D_{37} = 365 rads for x irradiation under anoxic conditions and n = 1.6 and D_{37} = 160 rads for x irradiation under oxygenated conditions. The cell system employed conforms in its radiobiological behavior with other mammalian cell culture systems and constitutes a useful test system for the study of cell radiobiological phenomena. The same or greater degree of apparent radiosensitivity was attained by direct neutron irradiation of cells in the anoxic state as was attained by x irradiation in the oxygenated state. Radiosensitivity cannot be defined in terms of a single RBE ratio but only in terms of the complete dose-response relationship or in respect to the parameters, n and D_{37}, which describe this relationship. (auth)

17497 MODIFICATION OF THE RADIATION EFFECTS ON THE REPRODUCTIVE CAPACITY OF TUMOR CELLS IN VIVO WITH PHARMACOLOGICAL AGENTS. Roger J. Berry and J. Robert Andrews (National Cancer Inst., Bethesda, Md.). Radiation Research, 16, 84-8(Jan. 1962).

The reproductive capacity of tumor cells from the ascites form of a transplantable murine leukemia was studied after treatment with 5-iododexoyuridine (IUdR) or 5-bromodeoxyuridine (BUdR) and/or x irradiation. The experimental criteria were the numbers of leukemic cells from control and variously treated tumor-bearing donor animals necessary to produce 50% takes in a group of recipient mice of the same strain. At doses of 300 mg/kg/day for 4 days, IUdR alone did not affect the reproductive capacity of leukemic cells but markedly enhanced radiation effects upon them (decreased the number of cells reproductively intact after given single x-ray doses). The amount of radiation potentiation was proportional to the dose of IUdR used. BUdR alone produced a moderate inhibition of tumor cell reproductive capacity but also potentiated radiation effect at low drug dose levels. (auth)

17498 THE EFFECT OF X-IRRADIATION ON GOLDFISH. I. THE EFFECT OF X-IRRADIATION ON SURVIVAL AND SUSCEPTIBILITY OF THE GOLDFISH, CARASSIUS AURATUS, TO INFECTION BY AEROMONAS SALMONICIDA AND GYRODACTYLUS SPP. I. L. Shechmeister, L. J. Watson, V. W. Cole, and L. L. Jackson (Southern Illinois Univ., Carbondale, Ill.). Radiation Research, 16: 89-97(Jan. 1962).

Graded doses (100 to 10000 r) of whole-body x radiation were administered to goldfish, Carassius auratus. The x ray $LD_{50(30)}$ was found to be 2315 r. Survival time decreased with increase in x-ray dose. Exposure to 100 r resulted in 100% mortality in 363 days; all fish exposed to 10,000 r succumbed in 11 to 14 days. Gross pathologic effects resulting from x irradiation are discussed. The transient phenomenon of external pigmentation development due to ionizing radiation was noted. The swim bladder, a hydrostatic organ, was frequently observed to be in a deflated condition after exposure to doses greater than 500 r, resulting in loss of buoyancy. The increase in the susceptibility of irradiated animals to an experimentally induced bacterial infection, Aeromonas salmonicida, and to a naturally acquired ectoparasitic trematode, Gyrodactylus spp., was also observed. (auth)

17499 EFFECT OF HALOGENATED PYRIMIDINES ON RADIOSENSITIVITY OF E. COLI. Henry S. Kaplan, Kendric C. Smith, and Patricia A. Tomlin (Stanford Univ., Palo Alto, Calif.). Radiation Research, 16: 98-113(Jan. 1962).

The incorporation of halogenated thymine and thymidine analogs into E. coli DNA during log-phase growth, though relatively nontoxic per se, was associated with a significant increase in sensitivity of the bacterial cells to x and uv irradiation. Although incorporation was linear with time from 2 to 10 hours of incubation, significant radiosensitization was not observed until 4 hours (17% replacement of thymine by 5-bromouracil) and was maximal at the end of log-phase growth (40 to 50% replacement), despite a further increment of incorporation during stationary phase. Labeling of only one strand of the DNA double helix was sufficient to confer at least half-maximal radiosensitization. The implications of the data for clinical radiotherapy are discussed. (auth)

17500 RADIOSENSITIVITY OF MICE AS A FUNCTION OF AGE. J. F. Spalding and T. T. Trujillo (Los Alamos Scientific Lab., N. Mex.). Radiation Research, 16: 125-9 (Feb. 1962).

RF female mice (1421) of ten age groups (2 to 21 months) were given acute exposures (450 rads) of Co^{60} γ rays at 14-day intervals until death. The median lethal dose for each group was calculated and reduced to a corresponding equivalent acute dose to determine the effect of age on radiosensitivity. It was concluded that radioresistance is relatively stable or unchanged through the first half of adult life, and then declines quite rapidly until the end of the normal life expectancy. (auth)

17501 IRRADIATION AND AGING: BEHAVIORAL IMPLICATIONS. Gilbert W. Meier, Donald P. Foshee, Adam P. Matheny, Jr., and Francine Carr (Vanderbilt Univ., Nashville). Radiation Research, 16: 130-7(Feb. 1962).

An attempt was made to estimate the significance of two apsects of irradiation and aging phenomena: the similarity of the effects of irradiation to those attributed to aging; and the additivity of the effects of one to those of the other. Two groups of subjects (CF/1 female mice; n = 7), 30 and 375 days old, respectively, were exposed to low levels of Co^{60} radiation for about 44 days (total dose: 1000 r). Two like groups served as controls. After 219 or 510 days of age, all subjects were tested for discrimination learning and at 286 or 577 days of age the subjects were conditioned on a Mowrer-Miller shuttle box. The four groups were differentiated on both tests, although with interactions involving age, irradiation, and testing conditions. The differences in the ordering of the groups as depicted on these two behavior tests were related to the very different behaviors required and were interpreted as indicative of changes in activity level: increased with irradiation and decreased with aging. The data support the conclusion that the effects of irradiation and aging may be nonanalogous and independent, but are additive, algebraically. Moreover, the data gave clues to the aspects of behavior most cogently measured for the designation of change with aging and irradiation; conversely, the differential changes with aging and irradiation may give clues to the mechanisms involved in these behaviors. (auth)

17502 A STUDY OF RADIATION-INDUCED AGING: RESPONSE OF IRRADIATED AND NONIRRADIATED MICE TO COLD STRESS. T. T. Trujillo, J. F. Spalding, and W. H. Langham (Los Alamos Scientific Lab., N. Mex.). Radiation Research, 16: 144-50(Feb. 1962).

RF female mice showed a linear decrease with increasing age in the ability to withstand a standard cold stress (6 to 7°C for 14 days). Mice of a standard age exposed to protracted Co^{60} γ-ray exposure (50 rads/day) and then allowed to recover for 90 days showed a similar linear decrease with increasing radiation exposure in the ability to withstand the same cold stress. The radioinduced effect was considered similar to life shortening by natural aging and was equivalent to 0.093 day/rad. (auth)

17503 REDUCED SURVIVAL TIME IN DESCENDANTS OF FIVE GENERATIONS OF X-IRRADIATED SIRES. J. F. Spalding and V. G. Strang (Los Alamos Scientific Lab., N. Mex.). Radiation Research, 16: 159-64(Feb. 1962).

The life span of nonirradiated descendants of five generations of x-irradiated sires was found to be significantly less than that of mice with the same degree of inbreeding but from ancestors with no history of exposure to ionizing radiation. The mean life spans for female and male mice of the nonirradiated or control line were 620 and 759 days, respectively, with a combined average for both sexes of 689 days. Female and male mice of the x-irradiated line showed mean life spans of 529 and 612 days, respectively, with a combined average of 570 days. The results are attributed to accumulated genetic damage but might conceivably be due to chance genetic selection at the time the separate lines were established. (P.C.H.)

17504 THE EFFECT OF WATER CONTENT AND POSTIRRADIATION STORAGE ON RADIATION SENSITIVITY OF BRINE SHRIMP CYSTS (EGGS). David W. Engel and Donald J. Fluke (Duke Univ., Durham, N. C.). Radiation Research, 16: 173-81(Feb. 1962).

Eggs of the brine shrimp Artemia salina were conditioned to various water content values and then were irradiated in air with doses up to 600 kr of Co^{60} γ rays. Scored for emergence of larvae, the driest eggs showed greater sensitivity than those at intermediate water content values. Water contents from 1.3 to 50% showed approximately uniform sensitivity, and eggs soaked in sea water at room temperature for 2 hours prior to irradiation were very sensitive. Dry eggs irradiated with 1-Mev electrons in a vacuum and at much higher dose rate showed a hatch rate decreasing not only with radiation dose but also with time

of subsequent storage in air. The observed effects of water content and postirradiation storage conditions for brine shrimp eggs are similar to such effects in barley seeds. (auth)

17505 CYTOLOGICAL ABERRATIONS OBSERVED IN BARLEY EMBRYOS. CULTURED IN IRRADIATED POTATO MASH. M. S. Swaminathan, V. L. Chopra, and S. Bhaskaran (Indian Agricultural Research Inst., New Delhi). Radiation Research, 16: 182-8(Feb. 1962).

Several cytological abnormalities were found during mitosis in the root tips of 2× and 4× barley when embryos excised from unirradiated mature seeds were grown on potato mash irradiated with 20, 40, and 80 kr of x rays. Critical scoring could be done only for cells containing micronuclei, and the frequency of such cells increased with the x-ray dosage. Cells with micronuclei also occurred in embryos grown on unirradiated potato mash, but their frequency was significantly increased when irradiated potato mash was used. The increase in the frequency of aberrant cells was lower in 4× barley and also when the embryos were grown in a pure O_2 atmosphere immediately after their transfer to the irradiated potato medium. The high moisture content of the potato tubers used for irradiation (70%) precludes the possibility that the radiomimetic principle involved could be either organic free radicals or stored energy. (auth)

17506 ACUTE RESPONSES OF THE VESTIBULAR APPARATUS TO X-IRRADIATION. Charles K. Levy and Henry Quastler (Worcester Foundation for Experimental Biology, Shrewsbury, Mass. and Brookhaven National Lab., Upton, N. Y.). Radiation Research, 16: 189-200(Feb. 1962). (BNL-5580)

Irradiation of the brain of hamsters with large doses of x rays produced a variety of motor and sensory disturbances. The syndrome was not acutely lethal. It showed two well-defined acute components, a general motor unrest, and disturbances in space orientation. Results of anatomical fractionation of the irradiation suggested that the motor unrest was associated with irradiation of a large part of the brain, whereas the inner ear was implicated as the structure most likely responsible for the acute alteration in space orientation. Histological studies corroborated this suggestion. Frequency and severity of the tilt response increase with dose in a sigmoidal curve, 50% incidence occurring at about 6 krad. Once the effect is manifested it is irreversible, but there was a rapid recovery from subthreshold doses. There appears to be a whole class of radiation responses which occur in highly specialized nondividing cells and have properties similar to those described for the inner ear response. (auth)

17507 TOXICITY OF TRITIATED THYMIDINE TO BONE MARROW TRANSPLANTS. Willie W. Smith, George Brecher, Frederick Stohlman, Jr., and Jerome Cornfield (National Cancer Inst.; National Inst. of Arthritis and Metabolic Diseases; and National Heart Inst., Bethesda, Md.). Radiation Research, 16: 201-7(Feb. 1962).

Damage in the precursors of blood cells due to incorporation of tritiated thymidine was evaluated in vivo. The parameter measured was the speed of recovery of peripheral blood cells after isologous marrow transplantation in irradiated mice. Donor animals received a total of either 20 or 40 μC of H^3-thymidine per gm of body weight. A delay in recovery was demonstrable only with small inocula, even after the very large doses of triated thymidine were administered. (auth)

17508 THE EFFECT OF GAMMA RADIATION ON COLLAGEN. J. H. Bowes and J. A. Moss (British Leather Manufacturers' Research Assn., Egham, Surrey, Eng.). Radiation Research, 16: 211-23(Mar. 1962).

Collagen was irradiated with 5- and 50-Mrad doses of γ rays under various conditions. Such doses lead to loss of crystallinity, as indicated by the x-ray-diffraction pattern, increase in solubility, and other changes in physical properties indicative of extensive loss of molecular structure and breakdown to smaller units. Determination of N-terminal residues using fluorodinitrobenzene indicates that there was relatively little hydrolytic scission of peptide bonds. Increase in amide nitrogen and in carbonyl groups indicates that —N—C— bonds were broken by a previously suggested mechanism. On irradiation with doses of 50 Mrad there was some loss of nitrogen and an over-all loss of some 10 to 20% of amino acids. The formation of carbonyl compounds accounts for only a small proportion of this loss, and large amounts of breakdown products remain unidentified. Relative losses of amino acids varied with the conditions of irradiation, but in general the acidic and basic amino acids and those having a ring structure were the most radiosensitive. The chemical changes occurring as a result of γ radiation are compared with those caused by other forms of degradation. (auth)

17509 THE CHEMICAL SENSITIZATION OF PSEUDOMONAS SPECIES TO IONIZING RADIATION. B. A. Bridges (Wantage Research Lab., Berks, Eng.). Radiation Research, 16: 232-42(Mar. 1962).

The sensitization of Pseudomonas sp. to radiation by N-ethylmaleimide and various other compounds was studied. Of compounds chemically related to N-ethylmaleimide which were tested, maleic anhydride and m-phenylenedimaleimide sensitized, and N-ethylmaleamic acid, maleic acid, and succinimide were inactive. It was concluded that the double bond in a five-membered heterocyclic ring is probably responsible for the sensitizing activity of this class of compounds; this is correlated with the ability to react with sulfhydryl groups. Two other sulfhydryl reagents, iodoacetic acid and phenylmercuric acetate, also sensitized Pseudomonas sp. No enhancement of radiation damage was observed when sensitizing agents were added within 1 minute after irradiation. A hypothesis was formulated elsewhere in which the breaking and reforming of disulfide bonds is postulated to be a mechanism of energy dissipation in bacteria. It is suggested that sensitizing agents might prevent this process by combining with the —SH groups or —Ṡ free radicals arising from bond breakage. (auth)

17510 EFFECT OF RADIATION ON DNA METABOLISM IN VARIOUS TISSUES OF THE RAT. IV. EARLY EFFECTS. Oddvar F. Nygaard and Richard L. Potter (Univ. of Michigan, Ann Arbor). Radiation Research, 16: 243-52(Mar. 1962).

Radiation effects on the incorporation of thymidine-2-C^{14} into DNA by spleen and small intestine were studied in the rat during the first $2\frac{1}{2}$ hours postirradiation. Relatively short exposures (1 minute) as well as incorporation periods (8 minutes) were employed in order to detect rapid and transient changes in the rate of labeling of DNA. The doses of irradiation ranged from 125 rep to 4600 rep of Co^{60} γ radiation and were given to the whole body. In both organs the incorporation of C^{14} into DNA was immediately depressed. At the lower dose level a temporary reversal of this effect was observed, followed by a progressive and sustained drop in the incorporation. The effect of irradi-

ation on the phosphorylation of thymidine to thymine nucleotides in the spleen was not of a sufficient magnitude to account for the decreased rate of incorporation of C^{14} into the DNA of that organ. The results obtained do not permit any conclusion as to whether the immediate effect observed represents a direct effect on the process of DNA synthesis. In the case of the later postirradiation periods, delayed onset of DNA synthesis and cell death may account for the observed effects. (auth)

17511 STUDIES OF THE MORTALITY OF A-BOMB SURVIVORS. I. PLAN OF STUDY AND MORTALITY IN THE MEDICAL SUBSAMPLE (SELECTION I), 1950-1958. Gilbert W. Beebe, Morishiro Ishida, and Seymour Jablon (Japanese Ministry of Health and Welfare and Atomic Bomb Casualty Commission, [Hiroshima]). Radiation Research, 16: 253-80(Mar. 1962).

Part of a life-span study, designed to evaluate the late mortality effects of radiation and other trauma received by the survivors of the Hiroshima and Nagasaki A-bombs, is reported. About 100,000 persons, including those exposed near to ground zero, persons exposed at such distances from ground zero as to guarantee that little radiation was received, and nonexposed immigrants to the cities, were studied. Mortality data for a subsample of 20,000 persons are given. The data were analyzed with respect to death rates from all causes and from certain major causes and groups of causes. No evidence of higher general mortality was found in the more heavily irradiated groups. When mortality from specific causes was studied, the well-known leukemogenic properties of radiation were clearly reflected, but radiation effects were not seen for other causes. An apparent effect in the area of anemia seems, at least in large part, to result from diagnostic difficulties in the blood dyscrasias, since some leukemias were so classified. (P.C.H.)

17512 FURTHER STUDIES ON THE CLONAL GROWTH IN HeLa S3 CELLS TREATED WITH TRITIATED THYMIDINE. Ruth M. Drew and Robert B. Painter (Brookhaven National Lab., Upton, N. Y.). Radiation Research, 16: 303-11(Mar. 1962).

The effect of intranuclear incorporation of H^3-thymidine on the clonal growth of HeLa S3 cells was studied, and the supression of colony development was shown to be a function of the variability of the uptake of the radioisotope by cells within clones. Autoradiograms showed that in young cultures the percentage of clones in which all cells were labeled after a 24-hr growth period in medium containing 0.1 μC of H^3-thymidine per milliliter was much greater than in older cultures having an average of about forty cells per clone. When similar cultures were permitted to incubate in nonradioactive medium after the growth period in radioactive medium, there was a greater suppression of colony development in the younger cultures than in those with more cells per clone. Variability in the uptake of H^3-thymidine by cells within clones was demonstrated to be a function of the degree of variability in the generative cycle of cells. A small fraction of cells appears to have a somewhat longer generation time than the average (22 to 24 hr). If the incubation time in the radioactive medium is extended to 48 hr, these cells incorporate the radioisotope, and colony development is completely suppressed. Survival curves for S3 cells cultured in varying concentrations of H^3-thymidine for 24 and 48 hr were established for comparison. Both curves indicate that a concentration of H^3-thymidine of the order of 0.02 μC/ml suppresses colony development. The lethal effect at this dose level is significant in the 48-hr treated cultures. (auth)

17513 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 22-Mevp X-RAYS, COBALT-60 GAMMA RAYS, AND 200-Kvcp X-RAYS. I. GENERAL INTRODUCTION AND PHYSICAL ASPECTS. W. K. Sinclair (Univ. of Texas, M. D. Anderson Hospital and Tumor Inst., Houston). Radiation Research, 16: 336-43(Mar. 1962).

Physical aspects of experiments on the RBE of Co^{60} γ rays and 22-Mevp x rays relative to standard 200-kvcp x radiation (HVL 1.4 mm Cu) are discussed. The physical conditions of exposure at a depth in a phantom and the necessary correction to the readings on a calibrating Victoreen chamber exposed at the specimen level are described in detail for all three radiations. The accuracy of the absorbed-dose estimates and their confirmation with the ferrous sulfate chemical dosimeter are also pointed out. (auth)

17514 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 22-Mevp X-RAYS, COBALT-60 GAMMA RAYS, AND 200-Kvcp X-RAYS. II. THE USE OF THE FERROUS SULFATE DOSIMETER FOR X-RAY AND GAMMA-RAY BEAMS. R. J. Shalek, W. K. Sinclair, and J. C. Calkins (Univ. of Texas, M. D. Anderson Hospital and Tumor Inst., Houston). Radiation Research, 16: 344-51(Mar. 1962).

Experimental G values for the radiolysis of ferrous ion to ferric ion in the ferrous sulfate dosimeter were determined as follows: 15.8 ± 0.5 molecules per 100 ev for 22-Mevp x rays; 15.8 ± 0.4 molecules per 100 ev for Co^{60} γ rays; 15.6 ± 0.5 molecules per 100 ev for Cs^{137} γ rays; and 14.6 ± 0.4 molecules per 100 ev for 200-kvcp x rays. These were compared with values in the literature and were found to be in fair agreement. The errors introduced by the use of the effective photon energy instead of a full x-ray spectrum were found to be small when water or tissue is substituted for dosimeter solution. Absorption coefficients, G values, and formulas are presented for use with the ferrous sulfate dosimeter at various photon energies. (auth)

17515 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 22-Mevp X-RAYS, COBALT-60 GAMMA RAYS, AND 200-Kvcp X-RAYS. III. DETERMINED BY ACUTE LETHALITY IN RATS. W. K. Sinclair and L. H. Blackwell (Univ. of Texas, M. D. Anderson Hospital and Tumor Inst., Houston). Radiation Research, 16: 352-62(Mar. 1962).

Determinations of the relative biological effectiveness of 200-kvcp x rays (1.4 mm Cu HVL), Co^{60} γ rays, and 22-Mevp x rays from a betatron were made by using survival of Sprague-Dawley rats as the criterion of effect, and estimating the absorbed dose to the soft tissue of the animals. Six simultaneous experiments were carried out at a dose rate of 40 rads/min. The RBE for Co^{60} γ rays versus 200-kvcp x rays was found to be 0.86; for 22-Mevp x rays versus 200-kvcp x rays, 0.85; and for 22-Mevp x rays versus Co^{60} γ rays, 1.00. It is pointed out, however, that the quantitative result can be varied (by means of the absorbed dose estimate) if critical tissues of different composition, or soft tissue surrounded by bone, are chosen. (auth)

17516 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 22-Mevp X-RAYS, COBALT-60 GAMMA RAYS, AND 200-Kvcp X-RAYS. IV. DETERMINED BY EFFECTS ON THE IRON-59 UPTAKE IN RATS. W. K. Sinclair, L. H. Blackwell, and R. M. Humphrey (Univ. of Texas, M. D. Anderson Hospital and Tumor Inst., Houston). Radiation Research, 16: 363-8(Mar. 1962).

A series of six simultaneous experiments was conducted with Co^{60} γ rays and 22-Mevp and 200-kvcp x rays. Fe^{59} was injected at the optimum time for each dose level, and

the 15-day uptake thereafter was determined. The effectiveness of the radiations was compared by choosing a comparable effectiveness level (ED_{50}) on the linear response curve. The average of six experiments yielded RBE values of 0.85 for Co^{60} γ rays versus 200-kvcp x rays, 0.84 for 22-Mevp x rays versus 200-kvcp x rays, and 0.99 for 22-Mevp x rays versus Co^{60} γ rays, based on the absorbed dose to soft tissue. (auth)

17517 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 22-Mevp X-RAYS, COBALT-60 GAMMA RAYS, AND 200-Kvcp X-RAYS. V. ABSORBED DOSE TO THE BONE MARROW IN THE RAT AND THE MOUSE. W. K. Sinclair (Univ. of Texas, M. D. Anderson Hospital and Tumor Inst., Houston). Radiation Research, 16: 369-83(Mar. 1962).

Calculations were made of the distribution of dose at the surface of semi-infinite tissue-tissue and bone-tissue layers for spectra of 200-kvcp x rays (0.5 mm Cu + 1 mm Al, HVL 1.4 mm Cu), Co^{60} γ rays, and 22-Mevp x rays. These calculations were applied to physical models of bone marrow cavities in the mouse and the rat, and the results were weighted for the gross distribution of active marrow in the animal. The distribution of functioning marrow across a cavity was assumed to be uniform. It was found that for both animals the bone marrow dose is greater than the soft-tissue dose in all three cases. The relative doses for the rat are 1.07 for 200-kvcp x rays, 1.01 for Co^{60} γ rays, and 1.01 for 22-Mevp x rays. The relative doses for the mouse are 1.09, 1.01, and 1.01, respectively. This suggests that, if mammalian RBE values are based on bone marrow dose, for both Fe^{59} uptake and lethality in the rat the RBE for Co^{60} vs 200-kvcp should be multiplied by 1.06, for 22-Mevp vs 200-kvcp the RBE should be multiplied by 1.06, and for 22-Mevp versus Co^{60} the RBE should be multiplied by 1.00. For the mouse, the RBE values should be multiplied by 1.08, 1.08, and 1.00, respectively. (auth)

17518 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 22-Mevp X-RAYS, COBALT-60 GAMMA RAYS, AND 200-Kvcp X-RAYS. VI. DETERMINED BY LETHALITY IN THE 4-DAY CHICK EMBRYO. R. M. Humphrey and W. K. Sinclair (Univ. of Texas, M. D. Anderson Hospital and Tumor Inst., Houston). Radiation Research, 16: 384-93 (Mar. 1962).

A determination of the relative biological effectiveness (RBE) of Co^{60} γ rays and 22-Mevp x rays versus 200-kvcp x rays was made, with lethality in the 4-day old chick embryo as the biological test object. A series of six simultaneous experiments was run with viability scored at 7 hr after the beginning of irradiation. The LD_{50} doses were 1015 rads for 200-kvcp x rays, 1100 rads for Co^{60} γ rays, and 1090 rads for 22-Mevp x rays. The RBE values obtained from this series were 0.92 for Co^{60} γ rays versus 200-kvcp x rays; 0.93 for 22-Mevp x rays versus 200-kvcp x rays; and 1.007 for 22-Mevp x rays versus Co^{60} γ rays. Two experiments were conducted with viability scored at 10 days after irradiation, with similar results. (auth)

17519 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 22-Mevp X-RAYS, COBALT-60 GAMMA RAYS, AND 200-Kvcp X-RAYS. VII. SUMMARY OF STUDIES FOR FIVE CRITERIA OF EFFECT. W. K. Sinclair (Univ. of Texas, M. D. Anderson Hospital and Tumor Inst., Houston). Radiation Research, 16: 394-8(Mar. 1962).

The effectiveness of Co^{60} γ rays and 22-Mevp x rays was found to be the same for five separate biological criteria (yeast LD_{37}, mouse LD_{50}, rat LD_{50}, Fe^{59} uptake in rats, and chick embryo LD_{50}) within the limits of experimental error. Thus there is presumably no difference in effect due to the pulse rate of the betatron producing the 22-Mevp x rays (except in the unlikely event that a possible energy effect and pulse effect cancel). When all doses are expressed in terms of the absorbed dose to soft tissue, the RBE for Co^{60} γ rays and 22-Mevp x rays relative to 200-kvcp x rays has an average value of about 0.87, but appears to range between 0.82 and 0.93, depending on the end point. (The mammalian end points studied here appear to have lower RBE values than do the nonmammalian end points.) If the dose in the mammalian cases is expressed as the absorbed dose to bone marrow, the RBE of the supervoltage radiations relative to 200-kvcp x rays for these end points is increased and the agreement between the RBE values for all the end points becomes very good. Co^{60} γ rays and 22-Mevp x rays can then be represented as less effective by a factor of 0.90 ± 0.02 than 200-kvcp x rays for all the biological criteria studied. Co^{60} γ rays are to be preferred to x rays in the 200 to 250-kvp region as a standard of comparison for RBE experiments. With Co^{60} γ rays as the standard, 22-Mevp x rays have an RBE of 1.00, and 200-kvcp x rays (absorbed dose to bone marrow) have an RBE of 1.10. No qualitative differences between the three radiations were evident. (auth)

17520 ACTIVE SITE OF DEOXYRIBONUCLEASE I. II. THE MECHANISMS OF THE RADIATION-INDUCED INACTIVATION OF DEOXYRIBONUCLEASE I IN AQUEOUS SOLUTION. S. Okada and G. Fletcher (Univ. of Rochester School of Medicine and Dentistry, N. Y.). Radiation Research, 16: 646-52(May 1962).

The kinetic properties of irradiated deoxyribonuclease in aqueous solution were determined. They show that the maximum velocity and the Michaelis-Menten constant decreased with increasing radiation dose. The D_{37} doses of the irradiated enzyme assayed at the low substrate concentrations were higher than those at the high substrate concentrations. These results were interpreted as indicating that the radiation effects on the active site of the enzyme can be further divided into the effect on the catalytic function of the enzyme and the effect on the substrate-binding ability of the enzyme. In deoxyribonuclease I, the enzyme was inactivated completely by the destruction of one tryptophan residue at the active site and activated partially by the radiation-induced strengthening of the substrate-binding ability. The latter effect was demonstrable only when the low substrate concentration was used for the enzyme assay systems. (auth)

17521 THE RELATIVE BIOLOGICAL EFFICIENCY OF 20-Mev ELECTRONS AND 250-kevp X-RAYS AS MEASURED IN THE 12-DAY-OLD CHICK EMBRYO. G. W. Cooper, J. G. Van Dyke, J. J. Nickson, and J. S. Laughlin (Sloan-Kettering Inst. for Cancer Research, New York). Radiation Research, 16: 686-91(May 1962).

The relative biological efficiency of 20-Mev electrons compared to 250 kevp x rays was determined from the absorbed dose-mortality curve for the 12-day-old chick embryo. The criterion for death was the visual appearance of the embryo in candling of the intact egg. Initial death is defined as death 20 to 24 hours after irradiation, and later death is defined as death after 16 days of incubation. Absorbed dose was determined from comparison measurements with ferrous sulfate dosimeters and ionization chambers. The RBE for producing initial death in chick embryos was found to be 0.82 ± 0.04, and the value for the later death was also 0.82 ± 0.04, the x rays being the more effective. (auth)

17522 RECOVERY OF TUMOR CELLS CULTURED IN VIVO AFTER X-RAY AND NEUTRON IRRADIATIONS.

S. Hornsey and G. Silini (Hammersmith Hospital, London). Radiation Research, 16: 712-22(May 1962).

Ehrlich ascites tumor cells were incubated intraperitoneally for various times between two dose fractions of either x rays or fast neutrons given in vitro. This procedure resulted in an increase of the surviving fraction of the cells compared to cells which received the total dose in one single shot. The rate of recovery appeared to be similar for the two radiations used, and recovery was at its maximum after 5 to 7 hours of incubation in mice. No recovery was observed when the cells were incubated in hypothermic mice at a temperature of 0.5 to 2°C. (auth)

17523 ACID DEOXYRIBONUCLEASE AND ACID PHOSPHATASE ACTIVITIES IN REGENERATING RAT LIVER AFTER WHOLE-BODY X-IRRADIATION. M. Goutier-Piroette and R. Goutier (Centre d'Étude de l'Énergie Nucléaire, Mol, Belg.). Radiation Research, 16: 728-35(May 1962).

Acid DNase and acid phosphatase activity were determined in regenerating livers of normal and irradiated rats. In normal rats, hepatectomy brings about an increase of acid DNase between 12 and 18 hours postoperation. The possible role of this increase in the mitotic cycle is discussed. Fifteen per cent of acid DNase and acid phosphatase activity is present in supernatant fraction of homogenates of normal and regenerating livers. This percentage is not changed in nonregenerating livers by irradiation by 700 r. In regenerating livers, however, irradiation with 700 r increases the percentage of free enzyme activity (from 15 to 30%) when it is given 10 minutes or 12 hours after hepatectomy. Irradiation 24 hours after hepatectomy no longer solubilizes the enzyme activities. (auth)

17524 EFFECTS OF IN VITRO X-IRRADIATION ON THE SURVIVAL OF MOUSE EGGS. Teh Ping Lin and Laurel E. Glass (Univ. of California, San Francisco). Radiation Research, 16: 736-45(May 1962).

A procedure for the in vitro x irradiation of unfertilized mouse eggs is described. Unfertilized oviducal eggs, obtained by superovulation of prepuberal C3H mice, were treated in vitro with doses of x irradiation ranging from 10 to 900 r and transplanted to recipient Cal A females in which fertilization and development occurred. Recipient females were autopsied 17 to 19 days later. Living and dead fetuses from donor and native eggs were identified and counted, and resorption sites were counted. The number of transplanted eggs failing to implant or dying very shortly after implantation was calculated. Thirty-eight per cent of control nonirradiated eggs survived and developed to term; in general, per cent survival decreased with increasing doses of irradiation. Death occurred at several developmental stages after irradiation. Only 1% of oöcytes receiving lethal doses of irradiation survived longer than the twelfth day of gestation; a higher proportion apparently died after implantation but before eye color could be distinguished. Death prior to implantation showed the best correlation with amount of x ray administered; it increased sharply with increasing dosage of irradiation. The data are represented by the following dosage classification: LD_{10-20}, 10 to 100 r; LD_{40-50}, 200 to 300 r; LD_{70-90}, 400 to 700 r; $LD_{99-99.9}$, 750 to 900 r. (auth)

17525 THE LETHAL EFFECTS OF X-IRRADIATION AND OF HYDROGEN PEROXIDE ON WILD-TYPE AND ON A HIGH-CATALASE MUTANT OF RHODOPSEUDOMONAS SPHEROIDES. H. I. Adler and R. K. Clayton (Oak Ridge National Lab., Tenn.). Radiation Research, 16: 746-52 (May 1962).

Data are presented to show that high levels of catalase in Rhodopseudomonas spheroides protect against inactivation by added hydrogen peroxide but not against inactivation by x irradiation. The degree of protection against hydrogen peroxide is in good agreement with theoretical predictions. Oxygen enhances damage by x irradiation but reduces damage caused by hydrogen peroxide diffusion into the cell. It is concluded that diffusing hydrogen peroxide is not a major intermediate in radiation damage of these cells. (auth)

17526 THE RELATION OF SEEDLING HEIGHT TO GENETIC INJURY IN X-IRRADIATED BARLEY SEEDS. Alessandro Bozzini, Richard S. Caldecott, and David T. North (Univ. of Minnesota, St. Paul). Radiation Research, 16: 764-72(May 1962).

Seeds germinated immediately after x irradiation and then grown for 7 days showed a near-normal distribution of seedling heights about the mean. However, when x irradiated seeds were stored at room temperature for 8 days before germination, the seedling height distribution about the mean was skewed and approached the bimodal. Determination of the extent of genetic injury in different seedling height classes in the material subjected to post-irradiation storage showed that there was an inverse relation between seedling height and genetic injury. On the average, seeds in the shortest height class evidenced between two and four times as many interchanges and mutations as seeds in the tallest height class. (auth)

17527 DOSIMETRY DURING CINERADIOGRAPHY AND OTHER SPECIALIZED RADIOGRAPHIC DIAGNOSTIC PROCEDURES. M. Paul Capp and Madison S. Spach (Duke Univ., Durham, N. C.). Radiology, 78: 744-50(May 1962).

Measurements were made of the radiation exposures in chest roentgenography, conventional fluoroscopy, image amplification with and without television, cineradiography, and biplane angiocardiography. This investigation, which extended over the past three years, included 5- and 8-inch Picker image-amplifier tubes and Vidicon and Orthicon television. On routine chest roentgenography in children the long-scale contrast technic resulted in significantly less radiation exposure than the short-scale contrast technic. Skin exposure from a 1961 8-inch Picker amplifier tube with Orthicon TV was significantly less than with other units used in the past three years. The importance of coning was shown and this was most effective in reducing right-angle scatter exposure. The total exposure was estimated for various radiological procedures used in the evaluation of children with heart disease. The greatest exposure resulted from the use of conventional fluoroscopy and biplane angiocardiography. (auth)

17528 AN INVESTIGATION OF THE EFFECTS OF IRRADIATION ON SERUM LEUCINE AMINOPEPTIDASE (LAP). C. A. Grimm (University of Oklahoma Medical Center, Oklahoma City). Radiology, 78: 811-15(May 1962).

Serum leucine aminopeptidase (LAP) is a proteolytic enzyme acting on the end-products of protein metabolism. Although its specific function in the blood has not been established, LAP has been found to be elevated in various inflammatory and neoplastic processes involving the hepatobiliary-pancreatic system and in the postoperative state. LAP readings were obtained on 43 patients before and after radiation therapy for malignant disease. With irradiation as a form of controlled, localized tissue injury, the results were evaluated as an index of the effect of tissue trauma on the circulating LAP leval. Only one patient had elevated LAP readings both before and after treatment. The possible association of high LAP concentrations and concurrent

hepatic metastases is discussed. There was impressive impressive uniformity of LAP activity in the two samples drawn on each patient. It is concluded that tissue injury produced by radiation therapy is not signaled by alterations in serum LAP. The type of neoplasm, course and duration of therapy, and total tumor dose had no demonstrable effect on the serum enzyme concentration. The elevations of serum LAP observed following surgery may be due to the characteristics of tissue trauma peculiar to operative procedures. This study confirms previous evidence that the LAP test does not indicate the presence of primary carcinoma which is unrelated to the hepato-biliary-pancreatic system. (auth)

17529 THE DANGERS OF RADIATION AND THE MEANS OF PROTECTION. J. A. Henry. Scalpel, 112: 1241-9(Dec. 26, 1959). (In French)

The dangers to man from radiation are considered, and the means of protection for medical appliances are reviewed. It is indicated that if these elementary precautions are observed accidents could be greatly minimized by our present knowledge. (auth)

17530 RADIATION THERAPY IN THE MANAGEMENT OF CANCERS OF THE ORAL CAVITY AND OROPHARYNX. Gilbert H. Fletcher and William S. MacComb. Publication Number 447, American Lecture Series. A Monograph in The Bannerstone Division of American Lectures in Radiation Therapy. Springfield, Illinois, Charles C. Thomas, 1962. 402p. $16.50.

The factors influencing definitive therapy, the techniques of treatment, and the problems of management of cancers of the oral cavity and oropharynx are discussed. Emphasis is placed on the integration of radiation and surgery. The clinical principles underlying management are considered from the standpoint of clinical varieties, patient care, and management of complications. Applications of radiotherapy to the specific management of squamous cell carcinomas are discussed in detail. Examples are presented of the various types of lesions for the anatomic sites, and an analysis of results and causes of failures and complications is included. A comprehensive manual for the calculation of dosages from interstitial implantations is also included. New methods are presented as well as the older standard methods. (140 references) (C.H.)

Radiation Sickness

17531 (AF-SAM-62-7) RADIOPROTECTIVE AGENTS. CELLULAR RESPONSE TO PREIRRADIATION TREATMENT WITH YEAST RNA. Donald E. Rounds (Pasadena Foundation for Medical Research, Calif.). July 12, 1961. 5p.

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The Fernandes strain of amnion cells treated with yeast RNA (0.01 to 0.5 mg/ml) 24 hr before 700 r gamma irradiation showed an increased survival over untreated cultures. A minimum RNA treatment of 8 to 10 hr was necessary to elicit a protective response in irradiated amnion cells. A dose curve over a 0 to 700 r range indicated cell survival as being represented by parallel lines rather than diverging lines. A delay in the onset of radiation damage to treated cultures was suggested. Daily counts indicated that treated cells multiplied at a normal rate of growth for 2 days post-radiation compared with an immediate inhibition of growth in untreated irradiated cultures. RNA protection appeared to operate on a mechanism different from that for thiol protection. (auth)

17532 (FTD-TT-62-144) EXPERIMENTAL DATA ON THE EFFECT OF ANTIBIOTICS ON CERTAIN MANIFESTATIONS OF ACUTE RADIATION PATHOLOGY. E. (Ye.) G. Dolgov. Translated from Antibiotiki, 6: 402-6 (1961). 9p.

In conditions of acute radiation sickness a study was conducted of changes in the tinctorial properties of tissues of white rats and the therapeutic effect of a combination of penicillin and streptomycin. Changes were detected in the sorption properties of the cellular protein structures. It was demonstrated that the application of combinations of antibiotics after exposure to radiation exerts a favorable action on certain manifestations of radiation sickness. (auth)

17533 (JPRS-13022) TWO ADDITIONAL CASES OF ACUTE RADIATION SICKNESS IN MAN. G. D. Baisogolov (Baysogolov) and A. K. Gus'kova. Translated from Klin. Med. (U.S.S.R.), 39: No. 11, 43-56(Nov. 1961). 29p.

Two individuals were exposed to whole-body neutron and γ irradiation during a laboratory accident. Both individuals developed marked symptoms of radiation sickness, differing as to extent and severity. Data on radiation dosages are tabulated. Clinical findings and treatment are described. Results are included of physical examinations 3 yr and 8 months after the accident. (C.H.)

17534 (JPRS-13415) THE MECHANISM OF FORMATION OF TISSUE HEMOLYSINS UNDER NORMAL CONDITIONS AND AFTER RADIATION INJURY TO ANIMALS. B. N. Tarusov and Yu. B. Kudryashov. Translated from Voprosy Biofiz., Biokhim. i Patol. Eritrotsitov, Akad. Nauk S.S.S.R., Sibirsk. Otdel., Inst. Fiz., Lab. Biofiz., Materialy Soveshch., Krasnoyarsk, 277-83, 1959 (1960). 15p.

A study to elucidate the characteristics of tissue hemolysins formed during in vitro autolysis was conducted on liver homogenates from rats, some of which were previously irradiated with whole-body gamma doses of 200 to 15,000 r. The activity of the tissue hemolysins during autolysis increases with the time of autolysis and is shifted to the left by whole-body irradiation. The effect of irradiation on the autolysis depends on the dose and the time elapsed after irradiation; for low doses, slight inhibition of autolysis occurred at first, followed by intensification, while for lethal doses, the reverse order occurred. The results indicate that tissue hemolysins appear in autolysis from breakdown of hemolysin-protein inhibitor complexes and that autolysis proceeds in a different way in nonirradiated and irradiated animals. (D.L.C.)

17535 THE REGENERATIVE ABILITY OF HEMOPOIETIC TISSUE FOLLOWING LETHAL X-IRRADIATION IN DOGS. Victor Perman, Eugene P. Cronkite, Victor P. Bond, and Dale K. Sorensen (Brookhaven National Lab., Upton, N. Y.). Blood, 19: 724-37(June 1962). (BNL-5688).

Successful treatment of the hemopoietic phase of the acute irradiation syndrome in dogs at the LD_{100} (400 r) dose is possible on an individual case basis with good nursing care. The onset and rate of regeneration is related to the radiation dose. Partial regeneration with subsequent death occurs with a 550 r dose. The control of infection during the critical period prior to regeneration appeared to be the limiting factor in successful treatment at the dose levels used in this study. (auth)

17536 HEMOPOIETIC REGENERATION IN CONTROL AND RECOVERED HEAVILY IRRADIATED DOGS FOLLOWING SEVERE HEMORRHAGE. Victor Perman, Dale K. Sorensen, Edward A. Usenik, Victor P. Bond, and Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). Blood, 19: 738-42(June 1962). (BNL-5687)

Dogs which had been heavily irradiated one to two years previously were severely bled. Both control and recovered dogs responded to the bleeding in a similar manner, indicating complete functional recovery of the previously irradiated marrow. (auth)

17537 Cx-REACTIVE PROTEIN IN RADIATION SICKNESS. S. E. Tukachinskii and V. P. Moiseeva (Leningrad Inst. of Blood Transfusion). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Translation), 52: 908-11(Feb. 1962).

The blood of rabbits irradiated with 800 or 1200 r x rays gave a positive reaction for Cx-reactive protein within 18 to 24 hrs after exposure. The dynamics of changes in the content of Cx-reactive protein reflected the course and gravity of the radiation sickness. An increase in levels of α-3-globulins occurred at the same time. Results of immunodiffusion tests confirmed the conclusion that at least two protein components appear in blood serum during radiation sickness that are not present in the blood of non-irradiated animals. (C.H.)

17538 CONCERNING THE APPEARANCE OF INCOMPLETE ANTIBODIES FOLLOWING BONE MARROW TRANSPLANTATION UNDER CONDITIONS OF RADIATION SICKNESS. PRELIMINARY REPORT. M. A. Umnova and M. N. Novikova (Lenin Inst. of Hematology and Blood Transfusion, Moscow). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Translation), 52: 941-3(Feb. 1962).

The nature of immunological processes in the so-called secondary disease was investigated in monkeys and dogs exposed to lethal doses of x radiation and given a subsequent injection of homologous bone marrow. Coomb's test was used for the demonstration of iso- and auto-immune antibodies. The formation of incomplete isoantibodies was demonstrated in one dog and one monkey by means of the indirect Coomb's test. Antibody fixation on their own erythrocytes was demonstrated by means of the direct Coomb's test in two monkeys following injections of bone marrow containing incompatible antigens. (C.H.)

17539 PROTECTION OF PRIMATES AGAINST LETHAL DOSES OF X-RADIATION. J. L. VanLancker, R. C. Wolf, and J. B. Mowbray (Univ. of Wisconsin, Madison). Nature, 194: 492-3(May 5, 1962).

Cysteine and AET were administered intravenously to rhesus monkeys immediately before exposure to x radiation at a dosage level of 100 and 500 mg/kg body weight, respectively. Epinephrine was injected subcutaneously to avoid collapse of blood pressure. A marked increase in the 30 day survival of rhesus monkeys receiving AET and cysteine prior to a whole-body x radiation of 800 r was observed. Five of six drug treated animals not only survived the 30 day period following exposure to 800 r, but were still alive and in apparent good health after 90 days following irradiation. In contrast, 5 of 7 unprotected animals died within 14 to 18 days following irradiation. A progressive decline in both leukocyte count and hematocrit was observed following x radiation in non-treated animals. In the protected animals, however, the degree of depression was less dramatic. No obvious effect of the drug was observed in the injected animals. In contrast, the non-injected animals presented the classical symptoms of radiation sickness. The results clearly demonstrate the practicality of protecting primates against 800 r administered during a period of 1 hr. (P.C.H.)

17540 EXPERIMENTS ON POSTIRRADIATION TREATMENTS WITH ASCITES TUMOR CELLS. Giovanni Silini (Medical Research Council and Hammersmith Hospital, London). Radiation Research, 16: 151-8(Feb. 1962).

Ehrlich ascites tumor cells were treated after x irradiation with chloramphenicol, and the percentage of abnormal anaphases was scored 15 hours after their reinoculation into mice. Over a dose range from 0 to 800 r given in nitrogen there was no significant difference between chloramphenicol-treated and untreated cells. If the cells were kept at 4°C for as long as 32 hours after irradiation, the appearance of the chromosome damage was delayed for a time corresponding to the length of time the cells were kept at low temperature, but the amount of chromosome damage was quantitatively unchanged. The same applied to cells kept at 19°C. No difference in the amount of chromosome damage was detected between cells kept in air or in nitrogen at 4 or 19°C for 10 hours after irradiation. (auth)

17541 THE PHARMACOLOGY OF RADIOPROTECTIVE CHEMICALS. ON SOME OF THE EFFECTS OF BETA-MERCAPTOETHYLAMINE (MEA) AND CYSTAMINE IN THE RAT. Melvin H. Heiffer, Roy L. Mundy, and Benjamin Mehlman (Walter Reed Army Medical Center, Washington, D. C.). Radiation Research, 16: 165-73(Feb. 1962).

A severe blood hypoxia and hypotension was produced in the rat by the administration of 100 mg of cystamine per kilogram. This is not the case when 125 mg of β-mercaptoethylamine (MEA) per kilogram is administered. Therefore, it is concluded that, although blood hypoxia and hypotension may be beneficial during cystamine-induced radioprotection, they are not present or necessary for the protection afforded by MEA. (auth)

17542 RELATIONSHIP BETWEEN METABOLIC RATE AND RECOVERY FROM RADIATION INJURY. Sol M. Michaelson and Lawrence T. Odland (Univ. of Rochester, N. Y.). Radiation Research, 16: 281-5(Mar. 1962).

Prediction of the recovery rate from whole-body ionizing radiation for man was done by relating basal metabolic rate for various species and their experimental half-time recovery from radiation injury. Based on this relationship, the recovery half-time for man is estimated to be between 15 and 22 days. (auth)

17543 WATER-ELECTROLYTE AND ANTIBIOTIC THERAPY AGAINST ACUTE (3- TO 5-DAY) INTESTINAL RADIATION DEATH IN THE RAT. S. Tom Taketa (Naval Radiological Defense Lab., San Francisco). Radiation Research, 16: 312-26(Mar. 1962).

The influence of water and electrolyte replacement therapy and treatment with antibiotics against acute (3 to 5 day) intestinal radiation deaths in rats exposed to an acute lethal dose of x radiation was studied. The administration of sterile 0.9% solution containing either NaCl or a mixture of NaCl, Na lactate, and KCl during the critical 2 to 5 day period after irradiation had little, if any, protective effect. However, treatment with antibiotics during the same period definitely increased the number of survivors. This antibiotic effect was enhanced significantly when NaCl, but not when equiosmolar glucose, was a constituent of the infusion solution given concurrently with the drug. The results strongly suggest that microorganisms may play a more prominent role than dehydration in the genesis of acute intestinal radiation death in the rat, but that dehydration must also be taken into account in the treatment of acute intestinal radiation injury. A comparison between whole-body and abdomen-only irradiated animals given a dose of 910 r showed that the therapeutic measures used were about equally effective against acute intestinal radiation death in the former as in the latter

cases. It was observed, however, that third-day deaths, which were so prominent in whole-body irradiated animals, were virtually absent in cephalic one-half-shielded, abdomen-irradiated animals. It was further observed that these therapeutic measures were ineffective against deaths occurring primarily as a consequence of radiation-induced injury to the hematopoietic system, as evidenced by the high incidence of deaths during the second postexposure weeks (the period usually associated with bone marrow radiation syndrome) in whole-body but not in partial-body irradiated animals. A large number of 5 day survivors, protected against acute intestinal radiation death by the combined saline and antibiotic therapy after 1000 r of x irradiation to the abdomen only, died during the subsequent week. These deaths, which occurred in bone marrow-shielded animals, apparently resulted from radiation injury sustained by the small intestine and not by any other abdominal viscera in the radiation field. (auth)

17544 PROTECTION OF THE IRRADIATED DOG BY AMINOETHYLISOTHIURONIUM (AET) AND p-AMINOPROPIOPHENONE (PAPP). Leonard T. Blouin and Richard R. Overman (Univ. of Tennessee, Memphis). Radiation Research, 16: 699-711(May 1962).

In mongrel dogs, a combination of 100 mg of aminoethylisothiuronium · Br · HBr per kilogram orally and 3 mg of p-aminopropiophenone per kilogram intraperitoneally, administered immediately prior to a total-body x-ray insult of 500 r, provided a high degree of radiation protection. Either drug alone at the same dosage did not improve survival rate over that of control animals. Evidence of a moderate degree of protection by the same combination against a total-body dose of 800 r was also apparent. The protective effects of the two agents against otherwise lethal radiation appear to be additive. (auth)

17545 CHEMICAL PROTECTION OF MAMMALS AGAINST RADIATION. J. -R. Maisin (Centre d'Études pour les Applications de l'Énergie Nucléaire, Mol, Belg.). Rev. franc. etudes clin. et biol., 6: 378-93(1961). (BLG-75). (In French)

A general review on the chemical protection against radiation damage in mammals is given. It is suggested that only compounds which reduce the 30 day mortality at an LD_{100} radiation dose by at least 50% or increase the $LD_{50/30}$ dose by at least 30% be considered. Compounds offering less protection or those providing only local protection contribute to the understanding of protective mechanisms but cannot properly be called protective. It is felt that increased efforts for a better understanding of the mechanism of action of AET and MEA as to their utilization in large animals and in specific systems including tumors should lead to the discovery of more effective and less toxic substances. It is also believed that the promise for chemical protection probably lies in the combination of some effective compounds which should protect a larger number of sensible points of the cellular metabolism. 174 references are given. (P.C.H.)

17546 COMPETITION BETWEEN LYMPHOID CELLS FROM DIFFERENT SOURCES IN RADIATION CHIMERAS. L. M. van Putten (Radiobiological Inst., Organization for Health Research T. N. O., Rijswijk Z. H., Netherlands). Transplantation Bull., 29: 49-51(Apr. 1962).

Irradiated F_1 (CBA × C57BL) hybrids were treated with CBA bone marrow and lymphoid cells. This treatment resulted in a high percentage of early mortality due to a graft-vs.-host reaction. It was found that the additional injection of lymphoid cells of old radiation chimeras (CBA in C57BL) could largely prevent mortality. It is assumed that in this situation the tolerant lymphoid cells of old chimeras compete with the intolerant parent lymphoid cells, with consequent decrease in the proliferation and lethal effect of the parent cells. (auth)

17547 THE FATE OF LONG-TERM ANORGANIC BONE IMPLANTS. C. Andrew, L. Bassett, Lloyd A. Hurley, and Frank E. Stinchfield (Columbia Univ., New York). Transplantation Bull., 29: 51-5(Apr. 1962).

The long-term fate of implants of anorganic bone, prepared by removal of organic fractions of heterogeneous bone, was studied histologically in dogs. After implantation in an orthotropic site the marrow-vascular spaces of anorganic bone were invaded by host osteogenic tissue. Subsequently, the anorganic material occupied space and was not remodeled significantly during a one-year observation period. Cathode-irradiated, frozen homograft controls were replaced by host bone with the passage of time. The clinical use of anorganic bone does not seem indicated from these studies. (C.H.)

17548 PROLIFERATION AND REJECTION OF TRANSPLANTED TRITIUM LABELED BONE MARROW CELLS IN MICE. H. Balner, E. B. Simmel, and D. A. Clarke (Sloan-Kettering Inst. of Cancer Research, New York). Transplantation Bull., 29: 55-63(Apr. 1962).

Tritium-labeled mouse bone marrow cells could be traced radioautographically for as long as 8 days after transplantation into irradiated recipients. Proliferating donor cells were shown to participate in the repopulation of the depleted hemopoietic and lymphatic tissues of the host, but it was difficult to explain initial regeneration exclusively on the basis of colonizing donor cells. Labeled donor cells injected into non-irradiated homologous hosts disappeared by the 4th day, suggesting a rejection time of 3 or 4 days. Rejection time was less than 18 hours if recipients were previously immunized against H-2 antigens of the donor. Rejection of donor cells was delayed if the recipients were injected shortly after birth. Radioautogr_phy is proposed as an accurate method to determine the rejection time of dissociated cells under various conditions. (auth)

17549 ABOLITION OF NEONATALLY-INDUCED HOMOGRAFT TOLERANCE IN MICE BY SUBLETHAL X-IRRADIATION. A. Fefer and G. J. V. Nossal (Stanford Medical Center, Palo Alto, Calif.). Transplantation Bull., 29: 73-9(Apr. 1962).

Tolerance of homologous skin in mice was induced by neonatal intraperitoneal injections of varying doses of homologous spleen cells. In two experiments, partial tolerance was induced by a single injection of spleen from $(DBA/2 \times C57BL/10)F_1$ and $(BALB/c \times C3H/6)F_1$ hybrids into DBA/2 and BALB/c newborns, respectively. In both cases tolerance was completely abrogated by 350 to 450 r of whole-body x irradiation. In two experiments, a high degree of tolerance was induced by using a strain combination sharing the H-2 antigens, i.e., BALB/c spleen cells injected into DBA/2 newborns, and by multiple injections of DBA/2 neonates with spleen cells from $(DBA/2 \times C57BL/10)F_1$ hybrids. Three possible explanations for breakdown of tolerance by irradiation are offered as working hypotheses for further experimentation. The massive proliferation which follows x irradiation may have reestablished the cells whose destruction had induced tolerance, the relevant antigen may have been diluted out by the irradiation and the subsequent cellular proliferation, x irradiation may have favored selectively a sensitized residual population of host cells which had been unaffected by

the neonatal injection of antigen. Preliminary results consistent with the 3rd hypothesis are presented. A possible clinical implication of the use of x irradiation to maintain unresponsiveness to a homotransplant is mentioned. (auth)

17550 EARLY DEVELOPMENT OF SPECIFIC GRAFT-TO-HOST TOLERANCE IN LYMPHOID AND MARROW RADIATION CHIMERAS. Leonard J. Cole and William E. Davis, Jr. (U. S. Naval Radiological Defense Lab., San Francisco). Transplantation Bull., 29: 79-82(Apr. 1962).

The mechanism of development of an immunogenic tolerant state in long-lived radiation chimeras was investigated in mice. Results are reported from studies of graft-to-host tolerance in both bone marrow and lymphoid cell radiation chimeras. The hypothesis that on early graft-host reaction results in latent, as well as overt, damage is discussed. (C.H.)

17551 BIBLIOGRAPHY OF BONE TRANSPLANTATION, ADDENDUM NO. V. C. Andrew L. Bassett, comp. (Columbia Univ., New York). Transplantation Bull., 29: 104-9 (Apr. 1962).

A list is presented of 144 references to recent literature covering various aspects of bone transplantation. (C.H.)

CHEMISTRY

General and Miscellaneous

17552 (AD-263735) STUDIES IN ELECTRON SPIN AND NUCLEAR SPIN RESONANCE SPECTROSCOPY. Edward W. Randall (Harvard Univ., Cambridge, Mass.). Aug. 1961. Contract Nonr-1866(13). 63p.

Measurements of the unpaired electron density in aluminum alkyl systems were made to explore the effects of structural and electronic changes on these densities. In other work, double magnetic resonance techniques were used to study the proton and N spectra in various compounds. An account of activities concerned with study of a broad line magnetic resonance spectrometer is included. (J.R.D.)

17553 (ORNL-3262) REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1962. (Oak Ridge National Lab., Tenn.). May 11, 1962. Contract W-7405-Eng-26. 216p.

Separate abstracts were prepared for thirty-one of the thirty-three sections. Of the sections not abstracted, the one entitled "Fission Product Transport" contained no information, the other, "Transport of Noble Gases in Graphite" is available in a more complete form as ORNL-TM-135 (NSA 16: 9209) (J.R.D.)

17554 (ORNL-3262(p.3-18)) HIGH-TEMPERATURE PHASE EQUILIBRIUM STUDIES. R. E. Thoma, H. A. Friedman, et al. (Oak Ridge National Lab., Tenn.).

Investigations of high-temperature phase equilibria were continued for systems having potential use in molten-salt reactor technology. Composition-temperature relationships of $LiF-BeF_2-ZrF_4-ThF_4-UF_4$ MSRE fuel mixtures were studied at 400 to 600°C. Phase diagrams were constructed for the systems $LiF-BeF_2-ZrF_4$, $KF-ThF_4$, $RbF-ThF_4$, $NaF-ThF_4-UF_4$, $NaF-YF_3$, and CrF_2-CrF_3. Investigations of phase behavior were continued in the $NaF-BeF_2-ZrF_4$ and $LiF-NaF-ThF_4$ systems which are of potential use as reactor-fuel reprocessing solvents. X-ray diffraction studies of the $LiSbF_6$ crystal structure were completed. Unit-cell measurements and space group assignments were made for the compounds $NaF \cdot YF_3$, $3KF \cdot UF_4$, $3KF \cdot ThF_4$, chromium(II, III) fluoride, $LiF \cdot RbF$, $LiF \cdot CsF$, and $6LiF \cdot BeF_2 \cdot ZrF_4$. Unsuccessful attempts were made to produce uranium(IV) oxyfluoride. Characteristic properties and/or methods of preparing the new compounds VF_3, $ZrOF_2$, ZrCl, $RbF \cdot SrF_2$, $CsF \cdot CaF_2$, and $CsF \cdot BaF_2$ were determined. (auth)

17555 (ORNL-3262(p.19-26)) COMPATIBILITY OF MSRE COMPONENTS. F. F. Blankenship, S. S. Kirslis, et al. (Oak Ridge National Lab., Tenn.).

In the Molten-Salt Reactor Experiment, a molten fluoride fuel containing UF_4 is exposed to a large area of graphite moderator surface. Because of the sensitivity of reactor behavior to the amount of U in the core, the extent to which fuel may penetrate the graphite is of considerable import. Since the fuel is nonwetting and pressure is a controlling variable in the permeation, a buoyancy balance was constructed to study the penetration of graphite by fuel over a range of pressures. The influence of Cs deposition, which arises from decay and burnup of fission product Xe migrating into the graphite, was also examined. The results, as established in the absence of radiation, continue to give evidence of favorable behavior for MSRE operation. An experiment designed to determine whether fissioning fuel in contact with graphite exhibits interfacial characteristics different from the non-wetting behavior shown out-of-pile was operated for 1580 hr at a fuel power density of 200 w/cc. The fuel, $LiF-BeF_2-ZrF_4-ThF_4-UF_4$ (69.5-23-5-1-1.5 mole %), contained in encapsulated graphite boats, reached maximum temperatures of about 900°C in undergoing 8.5% burnup of U^{235} and still remained nonwetting toward graphite; the graphite was virtually undamaged. Supplemental observations, some of which are still in progress, revealed that CF_4 was produced, that the frozen fuel appeared black because of discoloration by beta radiation, and that several other unusual or puzzling phenomena had occurred. The persistence of CF_4 was contrary to thermodynamic equilibrium and may have been favored by the experimental arrangement; the escape of CF_4 in the off-gas is potentially a serious problem, mainly because the effect is that of a strong reducing agent acting on the fuel. (auth)

17556 (ORNL-3262(p.27-30)) FLUORIDE SALT PRODUCTION. F. A. Doss, J. E. Eorgan, and J. H. Shaffer (Oak Ridge National Lab., Tenn.).

During 1961, approximately 4750 kg of various fluoride mixtures were prepared for the Molten-Salt Reactor Program and other Laboratory projects which utilize fused fluorides. In addition to production operations, various related services were performed to support engineering tests with molten-salt and liquid-metal systems, in-pile test programs, and experimental development projects. Continued efforts to improve both the fluoride purification procedure and the processing plant have resulted in substantial increases in the production rate of fused fluoride mixtures. (auth)

17557 (ORNL-3262(p.31-4)) CHEMICAL ASPECTS OF MSRE SAFETY. H. F. McDuffie, M. J. Kelly, et al. (Oak Ridge National Lab., Tenn.).

Questions related to the safety of the MSRE are raised by the possibility of accidentally mixing the fuel or coolant salts with water. Both short-term and long-term effects are important. The solubilities of the reactor coolant and the nominal reactor fuel in water were determined at 25°C and at higher temperatures up to 100°C. Uranium concentrations as high as 0.01 m were observed, suggesting that nuclear poisons be added to the water in case of an accidental fuel spill. Apparatus was devised and tested for laboratory studies of the short-term temperature and pressure effects of injecting molten fluoride salts into water. Calculations were made with respect to the possible release of radioactive I from MSRE fuel under various conditions; only in case of a spill in the presence of air does it appear that the liberation of free I would be expected. (auth)

17558 (ORNL-3262(p.35-51)) PHYSICAL CHEMISTRY OF MOLTEN-SALT SYSTEMS. S. Cantor, W. T. Ward, et al. (Oak Ridge National Lab., Tenn.).

Further studies of freezing-point depressions of NaF showed that solutes of trivalent fluorides caused negative deviations from ideality (the smaller the solute cation size, the greater the deviation) and that solutes of alkali fluorides caused mainly positive deviations (attributable to changes in London dispersion forces). Solutes of alkali fluorides caused freezing-point depressions in LiF somewhat different from those in NaF because of differences in Cou-

lombic forces. Excess partial molal free energies of mixing, calculated from liquidus temperatures in the system NaF–LiF, were expressible in terms of concentration and two constants. Densities of solid complex metallic fluorides were calculated, with an average error of 5.5%, by assuming that the molar volume of the complex is the sum of the molar volumes of the simple fluorides that formed the complex. This method of estimating densities facilitated the choice of number of molecules per unit cell for complex fluorides whose structures were under investigation. All the published density data on molten fluoride mixtures were re-examined in order to develop a more useful method of predicting densities of related systems. To a good approximation, the molar volumes of these melts were found to be expressed by an additive function of the components. By using empirically adjusted values for the molar volumes of the components of the melt and assuming additivity, the densities could be calculated to within 2% of the experimentally reported values. The enthalpy changes from 874.0 to 0°C were measured with a Bunsen ice calorimeter for samples of KF, LiF, and mixtures containing 0.193, 0.385, and 0.747 mole fraction of LiF. The calculated molar enthalpies of mixing when plotted vs composition gave an approximately symmetrical curve with a maximum at ~50 mole % LiF. Equilibrium constants have been carefully measured at elevated temperatures for the reaction $NiF_2 + H_2 \rightleftharpoons 2HF + Ni$, with the NiF_2 in unsaturated solution in an $LiF-BeF_2$ mixture and in several $NaF-ZrF_4$ solutions of varying NaF concentration, and with crystalline nickel present in large excess. These measurements all show the equilibrium constant, K_N, to vary with temperature and with solvent composition but to be independent of NiF_2 concentration; the activity coefficient of NiF_2 in these solutions is accordingly also independent of concentration of this compound. From the $LiF-BeF_2$ mixture (alone among those studied) the phase in equilibrium with the saturated solution is pure NiF_2; for such saturated solutions the activity coefficient (crystalline NiF_2 reference state) at any temperature is the reciprocal of the solubility at that temperature. Accordingly, from these activity coefficients and values of K_N in the $LiF-BeF_2$ solvent, free-energy values can be derived. Use of these values and of pertinent thermochemical data, either known or capable of reliable estimates in a third-law treatment, permits evaluation of $\Delta H^\circ_{298.16}$ and estimation of ΔF° values at other temperatures for the reaction with crystalline solid and (hypothetical) supercooled liquid NiF_2 as reference states. From the true equilibrium constant, obtainable directly from these free-energy values, and the K_N values, activity coefficients of NiF_2 have been obtained. These activity coefficients and their changes with solvent composition, especially those with supercooled NiF_2 as the reference state, offer suggestions as to the nature of such solutions. The temperature coefficients of the association constants K_1, K_2, and K_{12} for the formation of the species AgBr, $AgBr_2^-$, and Ag_2Br^+ in molten KNO_3, and of K_1 and K_2 for the formation of $CdBr^+$, CdI^+, $CdBr_2$, and CdI_2 in alkali nitrate mixtures indicate that the entropies of these associations are consistent with the "configurational" entropy calculated from the quasi-lattice model. The entropy of association of Ag^+ with the polyatomic ion CN^- is much more positive than for the associations with monatomic anions. The influence of solvent on the association constants for the formation of the associated species AgBr or AgCl in the molten solvents $NaNO_3$ and KNO_3 is consistent with the reciprocal Coulomb effect. The perturbation theory of Reiss, Katz, and Kleppa for systems with a common anion was extended to the third- and fourth-order terms to yield the equation for the excess free energy of mixing of uniunivalent salt mixtures: $(\Delta F^E/kT) = X_1X_2P\delta^2 + X_1X_2(X_1 - X_2)Q\delta^3 + [X_1X_2R + X_1X_2(X_1 - X_2)^2S]\delta^4 + \ldots$, where X_i is a mole fraction of component i, δ is related to the ionic sizes, and P, Q, R, and S are constants. The third- and fourth-order terms are necessary to rationalize experimental measurements in molten salts. An estimate of the contribution of London dispersion energy to the heats of mixing of mixtures of alkali nitrates with $AgNO_3$ or $TlNO_3$ is consistent with the observed differences between these mixtures and mixtures of alkali nitrates. This suggests a method of making estimates of this effect in mixtures containing other polarizable cations. (auth)

17559 (ORNL-3262(p.55)) CHEMISTRY OF PRESSURIZED-WATER REACTOR SYSTEMS. C. F. Baes, Jr. and T. H. Handley (Oak Ridge National Lab., Tenn.).

A study of the chemical and radiochemical behavior of the water in the pressurized-water loop at the Oak Ridge Research Reactor, in process, indicates that a large fraction of the water-borne activity (principally Mn^{54}, Fe^{59}, Co^{58}, and Co^{60}) is present as dissolved ionic material. The particulate material which can be removed by filtration is well crystallized and has the structure of magnetite. Appreciable radiochemical exchange may occur between the particulate and the dissolved material, suggesting that magnetite may be a suitable high-temperature filter and ion exchange medium for pressurized-water reactor coolant purification. (auth)

17560 (ORNL-3262(p.56-66)) PHASE EQUILIBRIA IN AQUEOUS SYSTEMS AT ELEVATED TEMPERATURES. W. L. Marshall, J. S. Gill, et al. (Oak Ridge National Lab., Tenn.).

Solubilities of UO_3 hydrates in the system $UO_3-SO_3-H_2O$ at 150 to 300°C are presented. The stable hydrates are shown to be $\alpha-UO_3\cdot H_2O$ at 150°, $\beta-UO_3\cdot H_2O$ at 225°, and $UO_3\cdot \frac{1}{2}H_2O$ at 300°C. In the five-component system $UO_3-CuO-NiO-SO_3-H_2O$, the compositions of solutions saturated simultaneously with the three solid phases, $UO_3\cdot \frac{1}{2}H_2O$, $CuO\cdot 3UO_3$, and $NiO\cdot 3UO_3$, are given at 300, 325, and 350°C in solutions varying from 0.002 to 0.06 m in SO_3. Solubilities of stoichiometric salts in H_2O at temperatures above 200°C were compiled and show that very little information exists for these systems at temperatures above 374°C. Sufficient study at high temperature on aqueous systems containing U might define regions of stability necessary to specify fuel compositions. Critical phenomena and regions of liquid-liquid immiscibility were defined in the systems $UO_3-CuO-SO_3-D_2O$, $UO_3-NiO-SO_3-D_2O$, and $UO_3-CuO-NiO-SO_3-D_2O$ at 280 to 410°C. At a fixed concentration of SO_3, the temperature of liquid-liquid immiscibility rose as the concentration of metal oxide decreased. Critical phenomena (defined as the disappearance of the meniscus between liquid and vapor) occurred at molal ratios, metal oxide : SO_3, below approximately 0.3. The effects of hydrostatic pressure in raising the temperature of liquid-liquid immiscibility were determined for several H_2O solutions of UO_3 and SO_3. The value of $\Delta t/\Delta p$ for stoichiometric UO_2SO_4 solutions was approximately constant at 0.08°C/atm at pressures up to 300 atm. The solubilities of $NiSO_4\cdot H_2O$ and several nickel oxysulfates in SO_3-H_2O at temperatures from 150 to 350°C and at SO_3 concentrations from 10^{-4} to 2 m are given. Comparative data in the D_2O systems are presented which show higher solubilities than in the H_2O system. In connection with evaluation of possible breeding blankets, the solubilities of ThO_2 in HNO_3-H_2O at 150 and 200°C are presented and are compared with previous data at 200 and 300°C. Details of a

high-pressure vessel incorporating Teflon as a gasketing material, used for equilibrating liquid-solid mixtures, are given. Vessels of this design were used at temperatures up to 500°C and at pressures up to 1000 bars. Data are shown for the solubility of H_2 in H_2O and of D_2 in D_2O from 260 to 300°C. Data are also given that show the effect on the solubility of H_2 in H_2O of a 2-1 and a 1-2 electrolyte at a concentration of 0.1 M from 0 to 120°C. The effect of 1 M $HClO_4$ in the same system from 20 to 120°C is also reported. (auth)

17561 (ORNL-3262(p.67-79)) PHYSICAL CHEMISTRY OF AQUEOUS SOLUTIONS. C. F. Baes, Jr., N. J. Meyer, et al. (Oak Ridge National Lab., Tenn.).

A study of Th(IV) hydrolysis at 94°C in 1 M $NaClO_4$ solution is in progress. Results thus far indicate that comparable hydrolysis occurs about one pH unit lower at 94° than at 25°C. While the hydrolysis mechanism, involving polynuclear species, is similar at the two temperatures, mononuclear species appear relatively more stable at the higher temperature. A study of U(VI) hydrolysis at 25 and 94°C was completed. Three hydrolysis products, in which the mole ratio $UO_2^{2+}:OH^-$ = 1:1, 2:2, and 3:5, were found to account adequately for the results. The best values of the corresponding equilibrium quotients were evaluated at the two temperatures by a least-squares computer code. This hydrolysis scheme accounts qualitatively for the solubility behavior of UO_3 in HNO_3 solutions at elevated temperatures. Analysis of the solubility data is being conducted to extend the temperature dependence of U(VI) hydrolysis to higher temperatures. Isopiestic ratios with reference to NaCl solutions have been obtained for four alkali chlorides and for magnesium and uranyl sulfates at 140°C. Osmotic coefficients for these solutes have been estimated from the data and by extrapolation of boiling-point data for NaCl solutions. The temperature dependence of the osmotic coefficients was qualitatively related to the comparative ability of the various ions to stabilize the ice structure of water. The effects of pressure up to 3000 bars, upon the specific conductances of solutions, were determined for 0.005 m H_2SO_4 at 30.1°C, for 0.005 m K_2SO_4 at 24.3°C, for 0.00218 m K_2SO_4 from 25 to 750°C, and for 0.0005 m K_2SO_4 from 25 to 600°C. The decomposition of peroxide in thorium nitrate-nitric acid solutions was only slightly catalyzed by ferric ion. Cupric-ion catalysis was similar to that observed in other systems. The insoluble thorium peroxynitrate formed by the addition of H_2O_2 to thorium nitrate solution corresponds to the stoichiometric formula $Th_6(OO)_{10}(NO_3)_4 \cdot 10H_2O$. Exploratory experiments for the purpose of determining the stability of Pa in thorium nitrate-nitric acid solutions were performed. The data obtained indicate that Pa does not precipitate rapidly from these solutions at 140 to 180°C, when in contact with Zircaloy and stainless steel surfaces. Pa^{231} was precipitated from 2 M $Th(NO_3)_4$ – 3 M HNO_3 by the addition of H_2O_2. Extraction of Pa^{231} from an aliquot of this same solution by diisobutyl carbinol indicated that the Pa^{231} was initially in true solution. (auth)

17562 (ORNL-3262(p.80-9)) CHEMICAL ASPECTS OF CORROSION OF ZIRCALOY-2. G. H. Jenks, J. E. Baker et al. (Oak Ridge National Lab., Tenn.).

Examination was completed on corrosion specimens exposed at locations in the core outlet, blanket, and circulating lines of the HRE-2 for various periods prior to run 20. Observations in near agreement with predictions from the in-pile loop program are as follows: (1) only small amounts of oxide remain on surfaces irradiated by fission recoils, with most of the oxide formed in such regions transported to other surfaces in the circulating system; (2) corrosion rates were 3 to 4 mpy for Zircaloy-2 exposed in the blanket side of the core and were negligible for specimens exposed elsewhere (none in the core); (3) corrosion rates were very low or negligible for Ti alloys; (4) corrosion rates were about 2.5 mpy for type 347 stainless steel in the blanket region; (5) penetration was comparable to that out-of-radiation for specimens in the circulating lines. The corrosion of stainless steel in the core outlet, however, was 3 to 5 times that predicted from the behavior of in-pile loops. Two in-pile autoclave experiments, designed primarily to provide information on the radiation corrosion of Zircaloy-2 at temperatures to 360°C in 0.08 m UO_2SO_4, 0.02 m $CuSO_4$, and 0.24 m D_2SO_4 in D_2O solution, failed by leakage before the design objectives could be achieved. However, the first autoclave, which remained intact for 350 hr out-of-pile at 360°C and for a short time at 280°C in beam hole HB-5 of the LITR, yielded some valuable information. The corrosion rate out-of-pile after the initial 50 hr was about 1.3 mpy, alpha counting of washed specimens after 124 hr exposure out-of-pile showed a very small amount of U sorption (0.24 $\mu g/cm^2$), and D–O recombination rate constants, K_{Cu} (from rates of pressure increase following initiation of irradiation), were shown to be 7×10^2, 1.9×10^3, and 6.6×10^3 liters(STP)/mole-hr at 230, 250, and 280°C respectively. All these data are consistent with previous observations or extrapolations. Equipment was assembled and tested for a study of the mechanism of corrosion of Zircaloy-2 after heavy-particle irradiation. Specimens will be irradiated in an inert environment and will subsequently be oxidized in 300°C steam with added oxygen. Weight-gain and capacitance measurements are expected to show variations which will yield valuable clues to the mechanisms of radiation corrosion. Sorption of sulfate and of U by hydrous zirconia from D_2O solutions of UO_2SO_4 (0.02 to 0.17 M) and D_2SO_4 (0.02 to 0.2M) was determined over the temperature interval 100 to 300°C. Surface area of the residual oxides varied from 545 to 100 m^2/g with temperature and with solution composition. Total sulfate sorption at 100, 200, and 250°C was markedly higher at acidities above 0.01, 0.03, and 0.05 M than for lower acidities because of increased (and multilayer) sorption of acid; no such marked increase occurred up to 0.15 M D_2SO_4 at 280 and 300°C. Amounts sorbed at lower acidities at all temperatures probably represent near-monolayer adsorption. U sorption per unit of surface area was nearly independent of temperature over the 100 to 300°C interval for solutions sufficiently acid to be truly stable. Sorption was less in solutions with 0.06 to 0.2 M acid than in solutions with 0.02 M excess acid, but no marked effects of the different initial acid concentrations of 0.06 to 0.2 M were observed. Sorption increased with increasing uranium concentration in the solution but did not exceed 0.004 millimole/cm^2. Acidities of the solutions generally decreased markedly during the exposure. Good values for the concentration of hydrogen ions and of other species in solution at temperature are probably required for complete interpretation of these results. Corrosion currents were determined as a function of potential and temperature (150 to 300°C) on passive Zircaloy-2 in oxygenated 0.05 M H_2SO_4. From the results the activation energy for the anodic partial process (oxidation of Zr) is 31.1 kcal/mole and is independent of potential and temperature in the range studied. The activation energy for the anodic partial process (reduction of O_2) is, however, a function of potential and temperature, being 10.8 kcal/mole at −1.400 v vs Pt between 220 and 300°C and changing to 5.4 kcal/mole at temperatures below 220°C.

At −1.200 v vs Pt the activation energy is 5.4 kcal/mole over the entire temperature range. On the basis of the data at 298°C, a model proposed by Vetter for passive Fe is suggested as an explanation for the corrosion behavior of passive Zircaloy-2. (auth)

17563 (ORNL-3262(p.90-8)) CORROSION BY SOLUTIONS. J. C. Griess, J. L. English, et al. (Oak Ridge National Lab., Tenn.).

A program designed to study the stress-corrosion cracking behavior of type 347 stainless steel in a boiling, simulated HRE-2 fuel solution (0.04 m UO_2SO_4, 0.02 m H_2SO_4, and 0.005 m $CuSO_4$) containing chloride ions was completed. Cracking frequency was independent of chloride ion concentration in the range 25 to 500 ppm; no cracking occurred at 10 ppm or less. Two different heats of type 347 stainless steel were used, and although both were within AISI compositional limits, specimens from one heat consistently showed a cracking frequency twice that of the other. When chloride was added to the solution as mercuric chloride, no cracking was observed; however, the addition of chloride ions to the solution containing mercuric chloride increased the cracking frequency. The presence of as much as 100 ppm dichromate ions in the chloride-containing solution inhibited cracking, and exposure of the specimens to a chloride-free fuel solution prior to exposure to the chloride-containing solution was very effective in minimizing cracking. Corrosion tests with QMV beryllium in deionized water at 250 and 300°C showed no significant attack after 120 days. Both with and without O in the system, a thin tenacious film was formed and a few small pits were observed. The coupling of Be to itself, to Zircaloy-2, or to stainless steel produced no adverse effects in degassed water. With O in the system, however, Be coupled to Zircaloy developed pits up to 6 mils deep on contact surfaces in 120 days, and Be coupled to stainless steel showed very severe corrosion, with pits as much as 125 mils deep in 60 days. BeO specimens corroded uniformly at 1.0 to 1.5 mpy at temperatures of 250 and 300°C. Corrosion test assemblies exposed in the steam generators of the HRE-2 were examined after the final reactor shutdown. Specimens of Ti, three stainless steels, and three carbon steels were not significantly corroded. The specimens indicated that many more years of useful service life could have been expected for the HRE-2 steam generators. A testing program to determine the adequacy of Al cladding for fuel elements in the High Flux Isotope Reactor was completed. It was shown that the corrosion of Al leads to the formation of an insulating layer of boehmite on the Al surface. Thus as Al, through which heat is being transferred at a constant rate, corrodes, the temperature of the Al increases. The rate at which the boehmite formed was constant under fixed conditions and was related to the temperature at the water interface and to the pH. The lower the temperature and the lower the pH (in the range 5.0 to 6.5 with HNO_3), the lower the rate of corrosion-product formation. Within the ranges of 300 to 900 psi and 31 to 51 fps, pressure and flow rate were without effect. It was concluded that 6061 Al will be a satisfactory cladding material for the HFIR fuel plates, provided the pH of the coolant is maintained at 5.0 or even 5.3 with nitric acid. A testing program was started to determine if Al can be used as cladding material for the fuel plates in the Advanced Test Reactor. Although the ATR is similar to the HFIR in many respects, the ATR fuel plates will operate at higher temperatures and for longer times. Tests to date have shown that at the higher temperatures the rate of oxide accumulation is not linear, as was the case at the lower HFIR temperatures, but is parabolic. Under the same conditions, X8001 and 6061 Al developed oxide layers at the same rate, and some oxide spontaneously spalled from both when thicknesses exceeded 2 to 3 mils. Specimens of 6061 Al from which oxide had spalled always showed localized attack, but under all conditions X8001 always corroded uniformly. Preliminary data suggest that the rate of oxide buildup on the Al specimens is related to the surface area of the stainless steel exposed to the coolant. Attempts to verify the observation are in progress. Corrosion tests in support of the Power Reactor Fuel Element Processing Program continued, and a screening program to select materials with adequate corrosion resistance for the transuranium processing facility has been initiated. During the year, 475 boiling 65% HNO_3 tests (ASTM: A262-55T) and 510 electrolytic oxalic acid tests (ASTM: A262-55T) were conducted. A continuation of the testing of Al alloys in various parts of the Oak Ridge Research Reactor has shown that many years of trouble-free service should be expected from the structural materials in the reactor, provided the present treatment practices are continued. (auth)

17564 (ORNL-3262(p.99-104)) SURFACE CHEMISTRY OF THORIA IN DILUTE AQUEOUS ELECTROLYTIC SOLUTIONS. C. H. Secoy, F. H. Sweeton, and H. F. Holmes (Oak Ridge National Lab., Tenn.).

Self-consistent measurements of the adsorption of HNO_3 on a particular thoria sample were obtained after several changes in experimental technique. Probably the most significant of these was the use of a commercial paint shaker to accelerate the equilibration rate. Complete interpretation of the data will not be attempted until additional measurements are made with other thoria samples. Progress on the design and construction of the high-temperature adiabatic calorimeter is reported. Several measurements of the heat of wetting of thoria at 25°C were made in a Dewar flask calorimeter with the instrumentation assembled for the high-temperature machine. The precision of the measurements is excellent, but the accuracy is not adequate. Changes in the design of the glass calorimeter are indicated and are being made. (auth)

17565 (ORNL-3262(p.107-9)) INVESTIGATION OF THE COMPATIBILITY OF COATED FUEL PARTICLES AND COATED MATRICES WITH LIQUID COOLANTS. (Oak Ridge National Lab., Tenn.).

A program to study the compatibility of coated fuel particles and associated matrices with liquid coolants was initiated. Particles of UO_2 coated with Al_2O_3, and UC_2 coated with pyrolytic C, supported in graphite matrices of various qualities, are to be tested in pressurized water and organic moderator-coolants and in various molten fluoride salts. Equipment capable of exposing electrically heated graphite rods to pressurized water was developed. Operation at heat fluxes exceeding 200,000 Btu hr^{-1} ft^{-2} was demonstrated. In a brief test in molten LiF−NaF eutectic at 900°C in a torch-fired vacuum crucible furnace, no dimensional change was observed on small sapphire (Al_2O_3) spheres. (auth)

17566 (ORNL-3262(p.110)) HYDRIDING OF ZIRCONIUM-BASE ALLOYS. (Oak Ridge National Lab., Tenn.).

An investigation was completed to determine the relative effects of variables associated with hydriding of Zr-base alloys during exposure to circulating aqueous slurries of ThO_2 and Th−U oxides in toroids at temperatures of 200, 280, and 330°C. Hydriding did not occur under oxidizing atmospheres. In reducing atmospheres with specimens exposed under conditions of slug flow in toroids, hydriding was not detected in 200°C tests, but severe hydriding

occurred at 280°C, and moderate hydriding occurred at 330°C. The rate and severity of hydride formation increased with increasing hydrogen overpressure and exposure time, and increased with the U/Th ratio of the slurry oxide. (auth)

17567 (ORNL-3262(p.111-13)) THORIA PELLET TEST PROGRAM. (Oak Ridge National Lab., Tenn.).

The program for evaluation of the integrity of ThO_2 pellets and sol-gel fragments was continued by use of standardized ball mill, autoclave, and spouted-bed tests. The attrition characteristics of pellets in small fluidized beds were also investigated, as a function of flow velocity and resultant bed expansion. It was found that wear rates increased as flow velocity increased, until increasing bed expansion resulted in less frequent collisions and the wear rate reached a maximum and diminished with further increase in flow. Wear rates were generally constant with time. At a bed expansion of 30%, wear rates slightly above 0.01%/hr were observed for 0.2-in. pellets. The rate at 400% expansion was 0.08%/hr, and at 900% expansion (near elutriation) it slightly exceeded 0.04%/hr. (auth)

17568 (ORNL-3262(p.114-22)) EXAMINATION OF IN-PILE SLURRY LOOP. (Oak Ridge National Lab., Tenn.).

Examination of cutup sections from in-pile slurry loop experiment L-2-27S, in which an aqueous thoria–0.4% urania slurry was circulated successfully for 2220 hr in beam hole HB-2 of the Low-Intensity Test Reactor, developing 7×10^{16} fissions per g of solids, did not reveal any instances of slurry deposition or localized attack. Slurry was found in the pressurizer and in the annulus of a sintered stainless steel filter which had cracked loose at one end, apparently prior to irradiation. The filter was not plugged. Recovery of all slurry drained from the loop and removed as samples permitted a material balance to be made: of 1590 g of solids put into the loop, 1579 g was recovered. Examination of corrosion specimens from the loop showed little effect of radiation and circulation velocity (at the levels of the experiment) on the attack of Zircaloy-2 or Ti alloys. Corrosion of type 347 stainless steel was increased, although not to excessive levels, by irradiation and by increased circulation. Progressive degradation of thoria particles was evidenced by the examination of samples taken at intervals during the run. Particle size decreased from 1.7 μ to 0.3 μ average diameter, crystallite size diminished from 1900 A to about 220 A, and surface area increased to over 40 m^2/g. These changes were confirmed by observations of pore volume and area distribution and by electron microscope photographs. Changes in particle properties in the loop experiment did not affect the slurry in ways leading to unsatisfactory handling. (auth)

17569 (ORNL-3262(p.123-5)) SECOND IN-PILE LOOP EXPERIMENT. (Oak Ridge National Lab., Tenn.).

The development and the fabrication of a loop for insertion into beam hole HN-1 of the Oak Ridge Research Reactor were completed. In this second in-pile loop experiment, an attempt will be made to irradiate pure thoria to a fission dose with in-bred U^{233} similar to or exceeding that of the first in-pile slurry loop experiment. A number of improvements in the loop are expected to increase substantially the effective irradiation of the slurry. (auth)

17570 (ORNL-3262(p.126-30)) IN-PILE SLURRY AUTOCLAVES. (Oak Ridge National Lab., Tenn.).

For comparison with the first in-pile slurry loop, identical materials were irradiated to similar doses in an in-pile autoclave experiment. Comparable changes in crystallite size and surface area occurred; however, only in the loop experiment, which involved pumped-slurry circulation, was the particle size reduced. Cyclotron irradiation of dry targets of pure thoria and thoria–0.4% urania was carried out to energy depositions in the particles of up to 6×10^5 w-sec per g of solids (exceeding that estimated for the in-pile slurry loop experiment) with the 28-Mev 63-in. N (3+) cyclotron and the 22.4-Mev 86-in. proton cyclotron. No change in crystallite size as indicated by x-ray line broadening was detected in the irradiated materials. (auth)

17571 (ORNL-3262(p.136-42)) DIFFUSION OF FUEL AND NONVOLATILE FISSION PRODUCTS IN FUEL-GRAPHITE SYSTEMS. C. M. Blood and R. B. Evans, III (Oak Ridge National Lab., Tenn.).

The feasibility of using coated fuel particles for nuclear reactors depends, in part, on the rate at which U and nonvolatile solid fission products diffuse through the coating material. Currently, it is expected that the coating material will be pyrolytic C, graphite, or both materials. Diffusion studies were made on high-permeability graphites, but there is very little definitive information available on diffusion rates in low-permeability coating materials. Solid-state diffusion studies were initiated, which have as their ultimate aim the study of pyrolytic graphites. The experimental program started with the fabrication of a UC–AGOT graphite diffusion couple. Satisfactory couples were made from U metal foil placed between two plane surfaces of graphite. The layer of UC formed when these materials were heated in a vacuum was thick enough to be considered infinitely thick in a theoretical treatment of the data. Present experimental work is concerned with reproducing experiments reported in the literature to test the procedure in use and to verify previously reported data. Emphasis is being placed on experimental methods at this stage of the program, since it is proposed to use a wedge technique frequently employed in autoradiographic diffusion studies of systems using tracers. This technique will amplify the penetration-concentration data considerably and should be an important device for obtaining good results. (auth)

17572 (ORNL-3262(p.143)) COMPATIBILITY OF SPECIAL FUELED GRAPHITES WITH WATER VAPOR. L. G. Overholser, J. P. Blakely, and N. V. Smith (Oak Ridge National Lab., Tenn.).

The compatibility of pyrolytic-carbon-coated carbide fuel particles and of uncoated fuel bodies, which are being considered for possible use in the Pebble Bed Reactor Experiment, with water vapor is being studied. The studies are being made at 800 to 1200°C with flowing He containing a maximum partial pressure of water vapor of nearly 1 atm. The rate of C removal is determined from weight changes, and the integrity of the coating on the fuel particle is evaluated by use of a HNO_3 leach. (auth)

17573 (ORNL-3262(p.144-5)) GAS–GRAPHITE REACTIONS. L. G. Overholser and J. P. Blakely (Oak Ridge National Lab., Tenn.).

Experimental studies were recently started for the purpose of measuring the reactivity of various grades of graphite with CO_2 and H_2O at low partial pressures (10 to 1000 volumes/million) in flowing He at 800 to 1200°C. Reaction rates will be determined from changes in weight of the specimens measured by a recording balance and from the composition of the effluent gas measured by a sensitive gas chromatograph. (auth)

17574 (ORNL-3262(p.146-7)) EVOLUTION OF GAS FROM GRAPHITE. L. G. Overholser and J. P. Blakely (Oak Ridge National Lab., Tenn.).

Additional studies were made of the degassing behavior of EGCR graphite. The release of S compounds (SO_2, H_2S, CS_2) as a function of graphite temperature was established, and the rate of release of desorbate was determined in the temperature range 500 to 1000°C. The rate of gas release in this temperature interval was found to be quite variable and not completely described by the equation $\nu = A \log t + B$ above 600°C. (auth)

17575 (ORNL-3262(p.148-52)) MEASUREMENT OF TEMPERATURE IN REACTOR ENVIRONMENTS. W. T. Rainey, Jr., R. L. Bennett, and H. L. Hemphill (Oak Ridge National Lab., Tenn.).

Tests to determine emf drift on bare-wire base-metal thermocouples in stagnant He atmospheres at 1000°C showed that the 80 Ni–20 Cr type alloys were less susceptible to selective oxidation than the 90 Ni–10 Cr type. Geminol-P and Chromel-A or -AA gave reliable emf data. In these tests, Special Chromel-P was no more reliable than the regular Chromel-P, but Special Alumel remained in good physical condition longer than the regular Alumel. It was established that selective oxidation might be observed at temperatures over about 700°C in a marginally oxidizing atmosphere. Chromel-P–Alumel couples sheathed with stainless steel were found to be of questionable reliability when exposed at 870°C to atmospheres containing gases desorbed from graphite. H diffusion into the sheath resulted in selective oxidation of Cr, with a consequent negative emf drift. The emf output was more stable at 704°C, staying within the specified tolerance (±¾% of the emf output) during long exposures. Exposure to CO at 870°C resulted in damage to the thermocouple wires and sheath, but without appreciable change in emf during the time of exposure. The damage occurred in relatively isothermal regions near the hot junctions. The reliability was dependent upon the source of material and the test conditions. Varying amounts of water, H, air, and C oxides inside the sheath seemed responsible for the differences among the materials furnished by different vendors. (auth)

17576 (ORNL-3262(p.153-6)) BERYLLIUM CHEMISTRY STUDIES. T. N. McVay, R. E. Thoma, et al. (Oak Ridge National Lab., Tenn.).

Measurements of the refractive indices of irradiated BeO specimens, made before and after thermal annealing, demonstrated that this technique affords a rapid method of measuring the extent of radiation damage to BeO. Attempts were made to produce a stabilized cubic form of BeO by doping with small amounts of other oxides. No evidence of the formation or stabilization of a cubic BeO phase was observed. A solvent-extraction process for making high-purity BeO was developed, and a small-scale production operation was demonstrated. About 1280 g of BeO was prepared. Spectrographic analyses of this material showed that impurity concentrations were reduced to exceedingly low values. Several batches of this high-purity BeO have found use in the preparation of spectrographic standard mixtures. Reports that the tensile strength of beryllia increases markedly as the purity and the crystal perfection are improved suggest that ultrapure BeO might display greater resistance to radiation damage. A spectrographic analysis method was developed for the simultaneous determination of beryllium acetylacetonate and acetylacetone in organic solutions which occur in the solvent-extraction Be purification process. It is based on the ultraviolet absorption peaks of the two components (294 to 272 mμ respectively), which are sufficiently separated that measured sample absorbancies at two wavelengths (260 and 301.5 mμ) can be used in simultaneous equations to obtain the concentration of each component, usually within ±5%. (auth)

17577 (ORNL-3262(p.157-60)) EFFECT OF RADIATION ON BERYLLIUM OXIDE. G. W. Keilholtz, J. E. Lee, Jr., et al. (Oak Ridge National Lab., Tenn.).

Severe damage was observed when sintered BeO was irradiated to high neutron doses at low temperatures. Specimens receiving 1.5×10^{21} nvt at 110°C disintegrated to powder, and those receiving 2.6×10^{21} nvt at 800 to 950°C fractured, but some specimens survived which were exposed to neutron doses and at temperatures between these limits. Samples irradiated to doses of approximately 10^{21} nvt showed increases in linear dimensions ranging from 0.5 to 4%, anisotropic lattice expansion and lattice defects, a decrease in the refractive indices, intergranular fracture, and void formation. These effects generally increased with dose and decreased with temperature. Essentially all the internally generated He was retained in the BeO, even at high temperatures with neutron doses up to 1.6×10^{21} nvt, but tritium was lost to an increasing extent above 120°C. Future experiments are designed to permit a better separation of variables in order to determine the relative importance of various possible mechanisms of irradiation damage. (auth)

17578 (ORNL-3262(p.161-2)) PHASE-EQUILIBRIUM STUDIES OF THE SYSTEM UO_2–ThO_2–O_2. H. A. Friedman and R. E. Thoma (Oak Ridge National Lab., Tenn.).

Equilibrium-phase relationships in the system UO_2–ThO_2–O_2 are being studied by long-term equilibration exposures to fixed conditions of temperature and O pressure, followed by chemical and crystallographic analyses of the products and by determinations of the relationship between O pressure and temperature in sealed systems of known original composition. Well-defined discontinuities in the relationship between O content and crystallographic lattice parameter were tentatively interpreted as marking the compositional boundaries to the single-phase solid-solution region. (auth)

17579 (ORNL-3262(p.166-71)) INFLUENCE OF IRRADIATION LEVEL ON FISSION PRODUCT HAZARDS ASSOCIATED WITH UO_2-FUELED REACTORS. G. W. Parker, G. E. Creek, and W. J. Martin (Oak Ridge National Lab., Tenn.).

Experiments were conducted with UO_2 fuel materials irradiated at tracer level, at 1000 and 4000 Mwd/ton to study the effect of burnup on fission product release resulting from the melting of fuel specimens and from oxidation and diffusion at temperatures below the melting point of UO_2. The results showed that, in general, increased releases were obtained with increasing burnup of U. The burnup effect was most noticeable in the increased amount of I released and in the increased rate of oxidation of UO_2 when the fuel was heated in air. When fuel was heated for 5.5 hr in pure He, however, the increase in diffusion of fission products with increased burnup was found to vary by a factor of 5 for I and Te and by a factor of 10 for Cs and Sr. A small but noticeable burnup effect on fission product release accompanying the melting of UO_2 in He, air, and CO_2 was observed. Data were obtained which showed the effect of gas velocity on the deposition rate of fission products that volatilized from molten UO_2. (auth)

17580 (ORNL-3262(p.172-6)) RELEASE OF FISSION PRODUCTS BY THE IN-PILE MELTING OF REACTOR FUELS. W. E. Browning, Jr., R. P. Shields, et al. (Oak Ridge National Lab., Tenn.).

In-pile experiments are being conducted to determine the amounts and form of fission products released when miniature fuel elements are melted by fission and gamma heat. Two experiments were completed in which stainless-steel-clad UO_2 fuel elements were heated in an experimental facility located in the Oak Ridge Research Reactor. The specimens were irradiated in the reactor only long enough to accumulate tracer quantities of fission products and were then inserted in the high-flux region of the reactor. The first specimen, enriched to 3%, was in the maximum flux region for about 20 min. The steel cladding melted, and it seems probable that most of the center portion of the specimen reached a temperature above, or very near to, the melting point of UO_2. Postirradiation examination of the specimen revealed that it had a relatively large hole extending about three-fourths of its length. The surface was covered with well-crystallized UO_2 that had undoubtedly been formed by deposition from the vapor phase. Radiochemical data indicate that most of the Ce^{144}, Y^{91}, and Sr^{90} remained in the UO_2 specimen; Xe^{133} and Ru^{106} were largely released, while Ba^{140}, Sr^{89}, and Cs^{137}, all of which have volatile precursors, were partly released. The specimen employed in the second experiment was 25% enriched to furnish more fission heat. It remained in the high-flux region of the reactor for about 10 min, and examination of the interior of the furnace after it was transferred to a hot cell showed that the specimen completely vaporized or melted and that most of the material collected as crystals on the wall of the thoria cylinder. A considerable amount of material deposited in the exit gas tube, and a portion of the thoria holder apparently melted. Radiochemical analyses of materials from this experiment are not available; consequently, release values remain to be determined. (auth)

17581 (ORNL-3262(p.177-84)) REMOVAL OF RADIOACTIVE FISSION PRODUCTS FROM AIR AND OTHER GASES. W. E. Browning, Jr., R. D. Ackley, and R. E. Adams (Oak Ridge National Lab., Tenn.).

The study of the containment, disposal, and removal of volatile or otherwise dispersible radioactive materials from gases continued. A method for removal of radioactive I from He at temperatures up to 650°C was developed with Whetlerite (charcoal impregnated with Ag, Cu, and Cr salts) as an adsorber. This process permits decontamination of gas-cooled reactor coolants at high temperatures. The efficiency of activated charcoal for removal of I from steam-air mixtures is being investigated for application to the emergency off-gas system of the NS Savannah. Tests of the efficiency of I collectors used for environmental monitoring on the NS Savannah were conducted. An investigation of the transport and deposition of radioactive aerosols was initiated to provide information for aiding in the control of the radioactivity which occurs in this form. Thus far, the study has been mainly concerned with diffusion, both as an important mechanism in aerosol behavior and as a basis for the determination of particle-size distributions. Air containing radioactive I vapor or finely divided particulate matter labeled with I^{131} is passed through cylindrical or rectangular channels, and the resulting longitudinal activity profiles are determined by means of a gamma spectrometer. The deposition profile for an aerosol or vapor is governed by the diffusion coefficient, which, in turn, depends on particle diameter or molecular properties in the case of a vapor. The initial results obtained appear promising with regard to aerosol characterization, since I-labeled particles approximately 0.25 and 0.004 μ in diameter behaved in accordance with theoretical equations adapted from the literature. Studies concerned with removal of radioactive Kr and Xe from coolants and other carrier gases continued at a slower rate than during the previous year. Equilibrium adsorption isotherms were obtained for Kr and Xe on charcoal at −45 and −78°C. Thermal-conductivity measurements were made with four types of charcoal containing He, N_2, or CO_2 in the voids. Apparent thermal conductivities decreased in the order He, N_2, and CO_2, in accordance with the behavior of the pure gases, but no significant differences were noted among the varieties of charcoal tested. A long-term Kr holdup test, with charcoal at liquid-N temperature and He as the carrier gas, was initiated and has now been in progress for eight months with no evidence of Kr breakthrough; for comparison, the average Kr holdup time at 25°C for the same trap and flow rate would be 5 min. Equations were developed for estimating effective diffusion coefficients, for a fairly wide variety of adsorber parameters, from readily obtainable data. (auth)

17582 (ORNL-3262(p.187-94)) PREPARATION OF PURE MATERIALS. C. F. Weaver, B. J. Sturm, et al. (Oak Ridge National Lab., Tenn.).

In the research program on the preparation of very pure materials in crystalline form, emphasis was placed on the purification of LiF and the production of defect-free single crystals, enriched in the Li^7 isotope. Solvent extraction of an aqueous Li salt solution with perfluorooctanoic acid in diethyl ether was used to remove Mg and other polyvalent cations; LiF was precipitated by the addition of the solution to aqueous HF; the dried precipitate was dehydrated at elevated temperatures in a Ni container in the presence of H and HF gas streams. The purified material was melted under vacuum and slowly cooled in a purified H atmosphere in a modified Stockbarger furnace to produce a 300-g ingot containing two crystals each of very high purity. Small single crystals of LiF were also grown from the vapor phase. The growth of single crystals of refractory compounds, particularly oxides, from molten solvents was brought under study on the basis of previous experience with the determination of high-temperature phase equilibria in systems involving oxides. Molten MoO_3, although it has a conveniently low melting point, was found to form a number of intermediate compounds with refractory oxides and thus proved unsuitable. Simple eutectic systems are formed between ceramic oxides and $Na_2B_4O_7$; crystals of ThO_2, ZrO_2, and TiO_2 were produced from this solvent, and it proved possible to grow seed crystals directly on Pt stirring rods without the usual difficulties of mechanical attachment. Very encouraging results were obtained with the growth of oxide crystals from molten fluoride mixtures; MgO and TiO_2 (rutile) were produced as good crystals, and evidence was obtained that UO_2, ThO_2, and ZrO_2 should also be stable phases on exposure to the fluoride solvents. A literature review of the solvent extraction of various metallic ions by dialkylphosphoric acids [of the structure $(RO)_2P(O)OH$, HX] was carried out. At low loadings the extraction reaction $M^{z+}_{aq} + zH_2X_{2\,org} \rightleftharpoons M(X_2H)_{z\,org} + zH^+_{aq}$ (in which the extractant is dimeric in the organic phase) appears to be quite general. The corresponding equilibrium quotient varies reasonably uniformly with ionic charge and radius when compared for the same reagent and diluent. At high loadings, various polynuclear extraction complexes, sometimes involving aqueous anions, often occur. These complexes, as well as mixed "synergistic" U(VI) complexes formed in the presence of neutral phosphates [e.g., R_3PO or $(RO)_3PO$], merit further study. (auth)

17583 (ORNL-3262(p.195-6)) RADIATION CHEMISTRY OF ORGANIC MODERATORS. W. T. Rainey, Jr. and L. B. Yeatts, Jr. (Oak Ridge National Lab., Tenn.).

Samples of pure biphenyl were pyrolyzed at 490°C for 48 hr. After separation of the products of a given pyrolytic sample into three different boiling fractions in a vacuum system, they were analyzed gas chromatographically with He as the carrier. The low-boiling fraction was resolved on a 6-ft column of a molecular sieve (Linde No. 5A) at room temperature and was shown to consist of H and CH_4. The intermediate-boiling material consisted solely of benzene, as identified on a 12-ft column of Chromosorb P with a static phase of 30 wt % Apiezon L and 2 wt % Carbowax 20 M, with temperature programming between 125 and 250°C. Finally, a 12-ft column of Chromosorb P with 20 wt % LiCl as the stationary phase was used to separate and, in some instances, to identify the components of the high-boiling fraction of the pyrolytic products. Through the use of temperature programming between 200 and 350°C, the presence of o-, m-, and p-terphenyl has been established. (auth)

17584 (ORNL-3262(p.199-205)) SHERWOOD PROJECT CHEMISTRY. R. A. Strehlow, J. D. Redman, et al. (Oak Ridge National Lab., Tenn.).

The experimental program of support for the Sherwood Project is largely devoted to studies of methods of obtaining and measuring high vacuum. The response of conventional glass-enveloped ionization gages at low pressures was compared under several test conditions with similar assemblies after substitution of a metal screen for the glass envelope. Plots of pressures read from these two types of gages show a curvature which diminishes with decreasing emission current on the screened gage and an absolute difference in reading which varies with several test conditions; the type of oil used in the diffusion pump was found to be an important factor. (auth)

17585 SECONDARY ISOTOPE EFFECT IN THE ADDITION OF HYDROGEN ATOMS TO PROPYLENE-d_6. M. Takahasi and R. J. Cvetanović (National Research Council, Ottawa). Can. J. Chem., 40: 1037-40(May 1962). (NRC-6746)

Reactions of H atoms produced by mercury-photosensitized decomposition of butane and C_3H_6 or C_3D_6 were carried out at 25°C in mixtures of 450 mm butane and varying small amounts of olefin. The secondary isotope effect in the addition of H atoms to C_3D_6 and C_3H_6 was found to be $k(D)/k(H) = 1.078 \pm 0.037$. (D.L.C.)

Analytical Procedures

17586 (AERE-R-3951) THE CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF URANIUM USING A SILVER GAUZE WORKING ELECTRODE. G. W. C. Milner and J. W. Edwards (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 9p.

The suitability of a silver-gauze working electrode for the determination of uranium by controlled-potential coulometry is investigated. Details are given of a quantitative procedure that is applicable to amounts of uranium of about 1 mg and greater in N sulphuric acid. Bismuth, copper, and molybdenum are shown to cause interference in the determination, and the presence of mercury is shown to have a deleterious effect on the working electrode. (auth)

17587 (HW-SA-2530) THE ANALYSIS OF URANIUM AND THE TRANSURANIUM ELEMENTS BY X-RAY FLUORESCENCE SPECTROMETRY. R. J. Kofoed (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 2, 1962. Contract AT(45-1)-1350. 9p.

Procedures for liquid and powdered samples are given along with tables of data on principal L series x radiation emission lines. (J.R.D.)

17588 (PG-Report-284) THE DETERMINATION OF PLUTONIUM IN URINE BY DIRECT PHOSPHATE PRECIPITATION AND AUTORADIOGRAPHY. J. C. Dalton (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 30p.

Development and use of a method for routine determination of Pu in urine is described. Existing methods are surveyed, and the grounds for the selection of an American procedure as being the best available starting point are discussed. The reasons for the subsequent modifications to some parts of the apparatus and the extensive alterations made in the chemical separations are given. The quantitative electrodeposition of Pu is discussed and details are given of the technique for the autoradiographic determination of the Pu content of the sources so prepared. The performance of the method under routine operating conditions, and the possible means of improving the procedure are discussed. (auth)

17589 (PG-Report-292) A MANUAL OF METHODS FOR THE ANALYSIS OF ANHYDROUS HYDROGEN FLUORIDE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 25p.

A manual is presented for preparing dilute solutions of anhydrous HF in glacial acetic acid, and for analyzing the HF in this dilute form. Water is determined in the undiluted acid conductimetrically. Sulfur dioxide, total S, hydrogen sulfide, and silicon tetrafluoride are determined in the dilute solutions iodometrically, gravimetrically, absorptiometrically, and iodometrically, respectively. (T.F.H.)

17590 (PG-Report-318) ANALYTICAL METHOD FOR THE RAPID DETERMINATION OF URANIUM DIOXIDE IN URANIUM TETRAFLUORIDE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 4p.

The method is based on the solubility of UF_4 in ammonium oxalate solution. Aluminum sulfate is used to complex fluoride ions so that the UO_2 remains undissolved. The solution is filtered and the residue determined gravimetrically as UO_2. (J.R.D.)

17591 (Y-1142(Del.)) THE APPLICATION OF SIMULTANEOUS COLLECTION AND AUTOMATIC COMPUTATION IN THE MASS SPECTROMETRIC ANALYSIS OF LITHIUM. Hugh O. Finley, Julian F. Been, Richard E. Sladky, and Chester R. Fultz (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Oct. 15, 1956. Contract W-7405-Eng-26. 41p.

A method of mass spectrometric analysis of lithium by simultaneously collecting Li^{6+} and Li^{7+} ions and automatically computing their atom ratio is described. The application of this method to routine assay of lithium iodide samples is discussed. (auth)

17592 (CEA-tr-R-1569) LA DÉTERMINATION DE L'URANIUM DANS L'EAU À L'AIDE DU MORIN. (The Determination of Uranium in Water with the Aid of Morin).

E. Upor. Translated into French by Z. Horusitzky from Hidrol. Közlöny, 38: 299-301(1958). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 13701.

17593 PLATE HEIGHT THEORY OF PROGRAMMED TEMPERATURE GAS CHROMATOGRAPHY. J. Calvin Giddings (Univ. of Utah, Salt Lake City). Anal. Chem., 34: 722-5(June 1962).

The theory of programmed temperature gas chromatography, particularly in relationship to the spreading of peaks as measured by the plate height is expanded. The significance of the plate height in programmed temperature operations is examined. The close relationship of this with the plate height in isothermal chromatography is discussed. Two phenomena which are unique to the programmed methods are treated theoretically. First is the zone compression at the head of the column which is a result of temperature being initially low followed by continual heating. Second is the effect of thermal lag which is responsible for a higher zone velocity at the wall than at the center of the column. This effect is treated in terms of the nonequilibrium theory which was developed for various plate height calculations in chromatography. (auth)

17594 PROPORTIONAL COUNTER ASSAY OF TRITIUM IN GAS CHROMATOGRAPHIC STREAMS. J. K. Lee, Edward K. C. Lee, Burdon Musgrave, Yi-noo Tang, John W. Root, and F. S. Rowland (Univ. of Kansas, Lawrence). Anal. Chem., 34: 741-7(June 1962).

An investigation was made on the factors that affect the accuracy and reproducibility of proportional counter analysis of tritiated radioactive components in gas chromatographic streams. The behavior of helium–methane and helium–propane flow mixtures is discussed extensively. The critical point for accurate assay is maintaining constant efficiency for tritium in various molecular forms. Variations in detection efficiency arise especially from coincidence losses at high count rates and from composition changes in the operating counter gas during the passage of a macroscopic peak. (P.C.H.)

17595 FLAME SPECTROPHOTOMETRIC DETERMINATION OF MICRO CONCENTRATIONS OF STRONTIUM IN CALCAREOUS MATERIAL. T. C. Rains, H. E. Zittel, and Marion Ferguson (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 778-81(June 1962).

A rapid and sensitive flame spectrophotometric method was developed for the determination of strontium in calcareous material. It is satisfactory for determining strontium in the concentration range from 0.1 to 1 μg per ml in the presence of 0.2 to 5 mg of calcium per ml. Strontium is determined at a wavelength of 460.7 mμ by means of a high-resolution flame spectrophotometer; calcium is used as a radiation buffer. Methods were devised for circumventing some of the common anionic interferences, such as phosphate and sulfate. Also, a previously reported procedure for the preparation of strontium-free calcium carbonate was improved. (auth)

17596 SPECTROCHEMICAL DETERMINATION OF BERYLLIUM IN AIR-BORNE DUST AT THE MICROGRAM AND SUBMICROGRAM LEVELS. R. L. O'Neil (General Motors Corp., Flint, Mich.). Anal. Chem., 34: 781-4 (June 1962).

A spectrographic procedure for the determination of beryllium in airborne dust was developed. Inplant sampling is done with a portable high volume air sampler. Samples are burned with the direct current arc in a controlled atmosphere of carbon dioxide gas using lutetium as the internal standard. Precision in the 2 to 50 μg range is from ±0.4 to ±4 μg at the 95% confidence level. The method is sensitive to 1×10^{-6}% by weight of beryllium or 1×10^{-4} μa of beryllium in the electrode. (auth)

17597 CONCENTRATION METHOD FOR THE SPECTROCHEMICAL DETERMINATION OF SEVENTEEN MINOR ELEMENTS IN NATURAL WATER. William D. Silvey and Robert Brennan (U. S. Dept. of the Interior, Sacramento, Calif.). Anal. Chem., 34: 784-6(June 1962).

A method for the quantitative spectrochemical determination of microgram amounts of 17 minor elements in water is given. The chelating reagents 8-quinolinol, tannic acid, and thionalide are utilized to concentrate traces (1 to 500 μg) of Al, Co, Cr, Cu, Fe, Ga, Ge, Mn, Ni, Ti, V, Bi, Pb, Mo, Cd, Zn, and Be. Indium is added as a buffer, and palladium is used as an internal standard. The ashed oxides of the 17 metals are subsequently subjected to direct current arcing conditions during spectrum analysis. The method can be used to analyze waters with dissolved solids ranging from less than 100 to more than 100000 ppm. There is no limiting concentration range for the determination of the heavy metals since any volume of sample can be used that will contain a heavy metal concentration within the analytical range of the method. Both the chemical and spectrographic procedures are described, and precision and accuracy data are given. (auth)

17598 SPECTROPHOTOMETRIC ANALYSIS OF LANTHANIDES IN MOLTEN NITRATE MEDIA. William T. Carnall (Universität, Munich). Anal. Chem., 34: 786-91 (June 1962).

The use of molten $LiNO_3$–KNO_3 eutectic as a solvent medium in which the absorption spectra of the lanthanides can be observed, made possible an extension of the normal spectral region of investigation into the near infrared to ~2.6 microns. Thus it was possible to demonstrate the existence of a number of lanthanide absorption bands in the 1.4 to 2.6 micron range, not previously reported in solution studies. The near infrared bands together with bands observed in the visible region of the spectrum should prove very advantageous in resolving mixtures of lanthanides. (auth)

17599 EFFECTS OF STREAMING ON VOLTAMMETRIC DATA. John W. Olver and James W. Ross (Massachusetts Inst. of Tech., Cambridge). Anal. Chem., 34: 791-4(June 1962).

The gross effects of streaming on several voltammetric techniques were investigated. Methods studied include chronopotentiometry with pool and hanging drop electrodes, controlled current polarography, and linear voltage scan at a hanging drop electrode. Under appropriate conditions of cell geometry, current density, purity, and composition of solutions, all the experimental techniques showed anomalous results which can be interpreted as streaming at the electrodesolution interface. The necessity of using maxima suppressors in these nonpolarographic techniques is demonstrated. (auth)

17600 POTENTIOMETRIC STUDIES OF THE TITRATION OF WEAK ACIDS WITH TETRABUTYLAMMONIUM HYDROXIDE. Leland W. Marple and James S. Fritz (Iowa State Univ., Ames). Anal. Chem., 34: 796-800 (June 1962). (IS-368)

The sources of amine, carbonate, and silver impurities in tetrabutylammonium hydroxide were investigated, and techniques for their removal were evaluated. The stability of the base in water, isopropanol, tert-butyl alcohol, and pyridine was determined. Salt bridge systems were de-

vised for acetone, isopropanol, tert-butyl alcohol, and pyridine. Titrations of weak and very weak acids using the glass indicating electrode were reproducible to within 2 to 5 mv. (auth)

17601 SPECTROPHOTOMETRIC DETERMINATION OF IRON IN URANIUM-FISSION ELEMENT ALLOYS. J. J. McCown and D. E. Kudera (Argonne National Lab., Ill.). Anal. Chem., 34: 870-1(June 1962).

A simplified procedure for the spectrophotometric determination of iron in uranium alloys containing Mo, Ru, Pb, Rh, and Zr was developed. Ammonium hydroxide was used to separate iron from molybdenum and the iron content was determined by measuring the absorbance of iron thiocyanate complex. The procedure was tested on synthetic solutions and was found to be satisfactory. It was also applied to the determination of iron in unirradiated uranium-5% fission element alloys used in EBR-II melt refining studies. Data are tabulated. (P.C.H.)

17602 SPECTROPHOTOMETRIC DETERMINATION OF YTTRIUM AND RARE EARTHS IN CAST STEELS. Bernard J. Bornong and John L. Moriarty (Lunex Co., Pleasant Valley, Iowa). Anal. Chem., 34: 871-3(June 1962).

A method for the quantitative spectrophotometric determination of yttrium and rare earths in cast steels was developed. The proposed method consists of the separation of yttrium or rare earth as fluoride from large quantities of iron by coprecipitation with thorium from a solution containing ammonium fluoride. The rare earth is further purified by a second coprecipitation using thorium oxalate as the carrier. The thorium is then separated by anion exchange and yttrium or rare earth determined spectrophometrically using the color forming reagent, arsenazo. Six to 12 determinations may be conveniently carried out simultaneously in 12 to 14 hr. The method appears to be applicable to many other steels where interfering ions would have soluble fluorides and oxalates. (P.C.H.)

17603 GAS-SOLID CHROMATOGRAPHY OF MIXTURES OF HYDROGEN ISOTOPES. George F. Shipman (Socony Mobil Oil Co., Inc., Prenceton, N. J.). Anal. Chem., 34: 877-8(June 1962).

Results of experiments on the separation of mixtures of H_2, HD, and D_2 by gas-solid chromatography using column packings prepared by three different procedures are described. The best results and shortest retention times were obtained with a column in which 1.8M $FeCl_3$ was added to 40 ml alumina and along with 50 ml water was titrated with 6M NH_4OH until a pH of 7 was obtained. Although with use the retention times of this packing decreased, it was very readily regenerated by conditioning with helium for 16 hr at 120°C. Differences in the three packings is believed to be due to the presence of excess NH_4OH and/or NH_4Cl. (P.C.H.)

17604 AN IMPROVED METHOD FOR THE DETERMINATION OF TRACE QUANTITIES OF PLUTONIUM IN AQUEOUS MEDIA. I. METHOD AND PROCEDURE. J. Kooi and U. Hollstein (Reactor Centrum Nederland, Hague). Health Phys., 8: 41-8(Feb. 1962).

Improvements were made on a recently published method for the determination of tracer amounts of plutonium in aqueous media. Essentially the method consists of a bismuth phosphate co-precipitation and an extraction with cupferron as a complexing agent. The method was considerably refined and its sensitivity was increased so that concentrations down to 10^{-10} μC/ml can be determined with a 100% yield. The method now applies to waters containing relatively large concentrations of iron and/or calcium. (P.C.H.)

17605 AN IMPROVED METHOD FOR THE DETERMINATION OF TRACE QUANTITIES OF PLUTONIUM IN AQUEOUS MEDIA. II. INTERFERENCE OF IRON, CALCIUM, URANIUM AND CHLORINE; APPLICATION TO SEAWATER AND URINE. U. Hollstein, A. H. M. Hoogma, and J. Kooi (Reactor Centrum Nederland, The Hague). Health Phys., 8: 49-59(Feb. 1962).

The applicability of the method for the determination of plutonium in aqueous media by solvent extraction with cupferron was extended. It is shown that relatively large quantities of iron and calcium do not interfere. In addition, the interference of uranium was studied. Modifications required for application of the method to urine and seawater are given. A nomogram is presented enabling the estimation of the relative importance of uranium and plutonium if both are present in the same sample. (auth)

17606 DETERMINATION OF THORIUM IN VARIOUS AQUEOUS SAMPLES BY ANION EXCHANGE. I. ADSORPTION OF THORIUM ON THE ANION EXCHANGE RESIN IN NITRIC ACID-ALCOHOL MIXED SOLUTION IN THE PRESENCE OF PHOSPHATE. Jun Akaishi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 154-60(Mar. 1962). (In English)

Adsorption of thorium on the anion exchanger Dowex 1-X8 in various nitric acid-ethanol mixed solutions and effects of phosphoric acid and the phosphate precipitates of calcium and magnesium were studied. When phosphate is present, thorium is strongly adsorbed on the resin in low and high concentrations of nitric acid and ethanol, respectively. In general, presence of phosphoric acid or phosphate decreases the adsorption of thorium in the nitric acid-alcohol mixed solution, but this decrease of adsorption is rather small. Thorium was adsorbed on the Dowex 1-X8 resin column (0.7 cm^2 × 2.8 cm) from 40% 1 N nitric acid-60% alcohol solution in the presence of phosphate, the column was then washed with 20% 1 N nitric acid-80% alcohol solution and demineralized water, and the elution was made with 2 N hydrochloric acid. The recovery of thorium was measured, using Th^{234} as a tracer. The results were quantitative for 0 to 380 μg of thorium. (auth)

17607 SIMULTANEOUSLY DETERMINING Pu AND U IN DISSOLVER SAMPLES. William J. Maeck (Phillips Petroleum Co., Idaho Falls, Idaho), Maxine E. Kussy, Thomas D. Morgan, James E. Rein, and Matthew T. Laug. Nucleonics, 20: No. 5, 80; 82-4(May 1962).

A rapid method for simultaneous separation of uranium and plutonium based on a batch liquid-liquid extraction system is described in order to show that the elements may be determined simultaneously by multiple-filament mass-spectrometry in which the ions measured are singly charged metal ions. The method provides a separated uranium-plutonium fraction free of cladding components, fission products, and americium and curium. Since the uranium-to-plutonium ratio is chemically controlled, both elements are determined with a single loading of the filament. With uranium-233 and plutonium-242 as added isotopes a series of simulated typical fuel-dissolver solutions were analyzed for uranium and plutonium concentration and isotopic distribution with precisions of better than 1% relative standard deviation. (N.W.R.)

17608 EMISSION-SPECTROGRAPHIC METHOD FOR THE DETERMINATION OF STRONTIUM IN SILICATE MATERIALS. K. K. Turekian, P. W. Gast, and J. L. Kulp

(Lamont Geological Observatory, Palisades, N. Y.). Spectrochim. Acta, 9: 40-6(1957). (NYO-9934(Vol.III) (p.75-81)).

A technique for the emission spectrographic determination of strontium in natural silicate materials is described. The effects of a varying matrix were diminished by the addition of strontium-free calcium carbonate. The technique gives a precision of 7 to 12% standard deviation. Comparison analyses with the stable isotope dilution method indicate a high degree of accuracy. (auth)

17609 METHODS OF AND MEANS FOR ASSAYING MATERIAL HAVING A FISSIONABLE COMPONENT. Ray A. Pritchett (to Floyd V. Richardson). U. S. Patent 3,018,374. Jan. 23, 1962.

A method and an apparatus are described for determining the U content of ore moving on a conveyer belt. The apparatus includes a thermal neutron source and a liquid hydrogenous phosphor container. In operation, the belt supporting ore particles is moved through the apparatus, in which the particles are bombarded with thermal neutrons and then the number of emissive events with a total energy per event the same as the sum of the energies of the prompt fission neutrons and gammas emitted by U^{235} is measured. Emissive events from the thermal neutron reaction of other components of the ore, e.g., silica, are gated out and not counted. An electronic scale is provided under the belt to indicate the ore weight. (D.L.C.)

General Inorganic and Physical Chemistry

Refer also to abstracts 17376, 17377, 17378, 17379, 17380, 17381, and 17383.

17610 (AERE-R-3942) THE PREPARATION OF CARBON SUBOXIDE. J. S. P. Batchelor, E. Furby, and K. L. Wilkinson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 9p.

Two methods for the preparation and isolation of pure carbon suboxide were examined: the pyrolysis of diacetyl tartaric anhydride and the dehydration of malonic acid. Final yields of the product were approximately 30% and 12 to 15%, respectively, and a high degree of purity was confirmed by mass spectrometric and chromatographic examinations. General observations on the handling, storage, and physical nature of the compound are made. (auth)

17611 (AFOSR-1519) RECOMBINATION RATES OF ALKALI METAL IONS. I. R. King (Texaco Experiment Inc., Richmond). Dec. 1, 1961. Contract AF 49(638)-650. 5p. (EXP-278; TP-168A)

Recombination rates of a number of alkali metal ions were determined at 1970°K and 1 atm. Results show that recombination coefficients vary in the same order as the ionization potentials of the ionized species. Ion-electron recombination is indicated. (auth)

17612 (DI-82-0149) EFFECTS OF AN ANHARMONIC POTENTIAL ON THE VIBRATIONAL FREQUENCY OF A MONATOMIC CHAIN. Kwong-Tin Tang (Boeing Scientific Research Labs., Seattle). Dec. 1961. 9p.

For the calculation of the vibration frequency of a lattice, a potential including an anharmonic third-order term is derived and its effect on the dispersion relation examined. The calculation is applied to a linear monatomic chain with nearest-neighbor interaction. (D.L.C.)

17613 (GCM/UK/23) THERMAL REACTIONS IN THE SYSTEM CARBON, CARBON MONOXIDE, CARBON DIOXIDE. J. W. Brightwell (General Electric Co., Ltd. Central Research Labs., Wembley, England). [1961]. 25p.

Presented at Libby-Cockcroft Meeting on Gas Coolant Compatibility, Harwell, Berks, England, April 1962.

Experiments were carried out on the reaction of a variety of carbons with carbon dioxide in the temperature range 500 to 800°C and with carbon monoxide between 280 and 350°C. It is shown that the reactivity of P.G.A. graphite with carbon dioxide may be reduced by carefully regraphitizing the graphite and cooling it in an inert atmosphere. Pre-irradiation of P.G.A. graphite had no observable effect on the subsequent reaction with carbon dioxide at 700°C. The reaction rate of graphitized impermeable cellulose carbon is similar on a basis of burn-off rate to normal P.G.A. graphite. It is believed that this is due to the high catalyst content of the impervious carbon which compensates for its very much lower available surface area. The reaction of the carbons with carbon dioxide below 550°C and with carbon monoxide below 350°C was studied by means of repeated applications of the gases at the reaction temperature (with intervening evacuations). At the end of each reaction period the gas was analyzed chromatographically. The carbon monoxide and carbon dioxide signals obtained in this manner never decayed to zero but it is not certain whether the rates reached a steady value. Tentative maximum values for gasification rates of these carbons are put forward on the assumption that the carbon monoxide signals finally obtained arose from steady gasification. For P.G.A. graphite these rates are 1.1×10^{-9} and 3.2×10^{-9} g/g-hr at 500 and 550°C respectively. The rate of carbon monoxide evolution during treatment of both virgin and regraphitized P.G.A. graphite with carbon dioxide at 650°C was found to increase with carbon dioxide pressure raised to a power which is less than unity. (auth)

17614 (GCM/UK/40) REACTION OF CARBON WITH ELECTRONICALLY EXCITED CARBON DIOXIDE. K. T. Claxton (Imperial Coll. of Science and Tech., London). Feb. 1962. 27p.

Presented at Libby/Cockcroft Meeting on Gas Coolant Compatibility, Harwell, Berks, England, April 1962.

An investigation was conducted on the effects of low-voltage electrons on $C-CO_2$ reactions. Results are discussed and presented graphically. (J.R.D.)

17615 (IS-300) SOME PHYSICAL AND CHEMICAL PROPERTIES OF SCANDIUM AND THE RARE EARTHS. Maynard Allyn Hiller and J. E. Powell (Ames Lab., Ames, Iowa). July 1959. 180p.

Conductances, densities, partial molal volumes, solubilities, and transference numbers were measured for scandium chloride, nitrate, and perchlorate. The stability constants of the chelates formed by the rare earths and scandium with ME(1,2-bis-[2-di(carboxymethyl)-aminoethoxy]ethane) and DE(2,2'-bis-[di(carboxymethyl)-amino]diethyl ether) were measured polarographically. In addition, the stability constants of the scandium chelates of HEDTA (N'-hydroxyethyl)-ethylenediamine-N,N,N'-triacetic acid), EDTA-(ethylenediamine-N,N,N',N'-tetraacetic acid), DCTA (1,2-diaminocyclohexane-N,N,N',N'-tetraacetic acid), and DETPA ((carboxymethyl)-bis-[2-di-(carboxymethyl)aminoethyl]amine) were also measured. (auth)

17616 (NP-11510) APPEARANCE AND IONIZATION POTENTIALS OF SELECTED FRAGMENTS FROM DECABORANE, $B_{10}^{11}H_{14}$. Technical Report No. 2. Joyce J.

Kaufman (RIAS. Div. of Martin Co., Baltimore); W. S. Koski (Johns Hopkins Univ., Baltimore); L. J. Kuhns and R. W. Law (Callery Chemical Co., Penna.). Mar. 19, 1962. Contract Nonr 3471(00). 48p.

The appearance potentials of selected ions from decaborane $B_{10}^{11}H_{14}$ (99.68% B^{11}) were measured mass spectroscopically. A set of apparently self-consistent ionization potentials for decaborane and various $B_{10}H_n$ fragments were calculated from these appearance potentials, using thermochemical bond energy data, combined with an interpretation of the processes taking place on ionization and fragmentation. An IBM 7090 computer program to calculate monoisotopic fragmentation patterns from mass spectral raw data was written. From the mass spectrum of $B_{10}^{11}H_{14}$ at 70 ev the monisotopic fragmentation pattern of decaborane was calculated. For comparison, from mass spectral raw data at 70 ev of decaborane containing normal isotopic abundances of B^{10} and B^{11}, several different monoisotopic fragmentation patterns of decaborane were calculated which varied depending upon the method of choice of the original % B^{10} in the molecule. (auth)

17617 (ORNL-TM-122) UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, NOVEMBER 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). May 16, 1962. Contract [W-7405-Eng-26]. 55p.

Operation of a 6-in.-dia foam separation column with Sr^{89} tracer and dodecylbenzenesulfonate as a surfactant and foaming agent was continued. The catalytic oxidation of H_2, CO, and CH_4 was studied using a nickel-chrome-palladium ribbon catalyst. A Mark I prototype fuel assembly was sheared to within 1.5-in. of the end by modifying the gas hydraulic system of the shear. The force required to shear a highly carburized Mark I fuel assembly (1.7-2.7% C) was ~25 tons compared to ~50 tons for the ductile tubing. Demonstration of the mechanical dejacketing of the SRE Core I fuel burned to ~675 Mwd/ton and cooled about 2 years is complete, and decontamination and equipment removal from the segmenting cell is approximately 90% complete. Ten SRE Core I fuel jackets were dissolved in aqua regia and analysis showed negligible U and Pu. A semicontinuous leach run, in which −2 mesh graphite fuel containing 2.6% U was leached in 90% HNO_3 at 60°C, gave only 0.37% U loss. Graphically estimated spectral factors for radiation between tubes within fuel bundles and improved wall radiation factors were used to calculate the temperature distribution expected within spent fuel elements. Further studies of the dissolution of zirconium oxide by HF in fused salt resulted in rates about twice as great as for Zr metal under similar conditions. (auth)

17618 (UCRL-6785) ESTIMATION OF HIGH-TEMPERATURE HEAT CAPACITIES OF CARBIDES. Oscar H. Krikorian (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 6, 1962. Contract W-7405-Eng-48. 5p.

High-temperature heat capacities of carbides were compared and found to define a family of curves. On the basis of the curves, and from comparisons of S_{298}^0 values, an expression was developed for the estimation of heat capacities of carbides. In order to use the expression, it is necessary to have values of S_{298}^0 for carbides. A table listing measured and estimated S_{298}^0 values is included. (auth)

17619 (AEC-tr-4456) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhurnal Neorganicheskoi Khimii, 3: No. 8, 1721-1990(1958). 376p. (PST-Cat.-378)

A cover-to-cover translation of Zhurnal Neorganicheskoi Khimii (Journal of Inorganic Chemistry) Vol. 3, No. 8 is presented. Separate abstracts were prepared for 9 papers. One was previously abstracted in NSA. (M.C.G.)

17620 (AEC-tr-4456(p.1-8)) THE PRESSURE OF DISSOCIATION AND SUBLIMATION OF RUTHENIUM TRICHLORIDE. S. A. Shchukarev, N. I. Kolbin, and A. N. Ryabov. Translated from Zhur. Neorg. Khim., 3: 1721-6 (1958).

The dissociation pressure of solid ruthenium trichloride was measured at 773 to 1058°K. From the data obtained on the dissociation pressure, the following changes in thermodynamical functions on dissociation were calculated: $\Delta H_{298} = 49 \pm 2$ kcal, $\Delta F_{298} = 35 \pm 2$ kcal, $\Delta S_{298} = 47 \pm 2$ e.u. The values for sublimation of $RuCl_3$ were determined at 850 to 1100°K. On the basis of these values the thermodynamical characteristics of the process of sublimation of $RuCl_3$ were determined for the average temperature of 975°K: $\Delta H = 46$ kcal, $\Delta S = 41$ e.u. (auth)

17621 (AEC-tr-4456(p.14-17)) SYNTHESIS OF HIGHER FLUORIDES OF NIOBIUM, TANTALUM, AND MOLYBDENUM WITH THE AID OF CHLORINE TRIFLUORIDE. N. S. Nikolaev, Yu. A. Buslaev, and A. A. Opalovskii. Translated from Zhur. Neorg. Khim., 3: 1731-3(1958).

This paper was previously abstracted from a French translation (CEA-tr-R-634) and appears in NSA, Vol. 13, abstract no. 12484.

17622 (AEC-tr-4456(p.153-65)) INVESTIGATION OF THE REACTION OF FORMATION OF COMPOUNDS OF CERTAIN RARE-EARTH ELEMENTS WITH HEXAMETHYLENEDIAMINETETRAACETIC ACID. A. A. Kuz'menko. Translated from Zhur. Neorg. Khim., 3: 1829-37(1958).

A study was made of the reaction of hexamethylenediamine tetraacetic acid with yttrium, lanthanum, cerium, and neodymium chlorides in aqueous solutions, to find the composition of compounds formed at various pH values of the solvent and excess of chelating agent. The electric conductivities of isomolar mixtures of the chelating agent with rare-earth elements were determined. Potentiometric titrations of the mixtures of the chelating agent with rare-earth elements were carried out. Complex compounds with the sodium salt of hexamethylenediamine tetraacetic acid were prepared. It was found that two types of complexes were formed in systems of the chelating agent and rare earth: $M_4(C_{14}H_{20}N_2O_8)_3$ or $HM(C_{14}H_{20}N_2O_8)$, where M is the rare earth. (M.C.G.)

17623 (AEC-tr-4456(p.225-30)) TERNARY SYSTEMS Na||Cl, MoO_4, WO_4, AND K||Cl, MoO_4, WO_4. Z. A. Mateiko and G. A. Bukhalova. Translated from Zhur. Neorg. Khim., 3: 1883-7(1958).

The ternary systems Na||Cl, MoO_4, WO_4, and K||Cl, MoO_4, WO_4 were investigated. The work was carried out by the visual-polythermic method: a thermocouple Pt-Pt/Rh and a millivoltmeter with a mirror reading device were used. The simplicity of the topology of these systems was explained by the formation of solid solutions. The systems showed a high stability of the solid solutions of sodium molybdate and tungstate and potassium molybdate and tungstate. In the system Na||Cl, MoO_4, WO_4, the formation of solid solutions was not limited to sodium molybdate and tungstate, but extended to their compounds with sodium chloride. The formation of the stable solid solutions was explained by similar effective ionic radii of molybdate and tungstate ions. (M.C.G.)

17624 (AEC-tr-4456(p.295-316)) EXTRACTION OF THORIUM WITH TRIBUTYL PHOSPHATE. E. P. Maiorova

and V. V. Fomin. Translated from Zhur. Neorg. Khim., 3: 1937-54(1958).

In order to determine the stability constants of thorium complexes with the sulfate ion, experiments were performed from which the distribution coefficients of ultramicroquantities of thorium between the aqueous phase containing the ions H^+, NO_3^-, and HSO_4^- and the solution of TBP in benzene were determined. It was found that in sulfate-nitrate solutions of thorium with an ionic strength of 1.7, in addition to simple sulfate and nitrate complex ions, complex ions of thorium with two ligands also exist. The ions with two ligands contained only one SO_4^{2-} ion, and not more than $3NO_3^-$ ions. The values of the stability constants of the complex ions and molecules $Th(SO_4)^{2+}$, $Th(SO_4)_2$, $Th(NO_3)(SO_4)^+$, $Th(NO_3)_2SO_4$, and $Th(NO_3)_2SO_4^-$ were found to be 200, 2500, 1950, 1100, and 500 respectively. (M.C.G.)

17625 (AEC-tr-4456(p.317-22)) EXTRACTION OF PROTACTINIUM BY ALKYL PHOSPHORIC ACIDS. V. B. Shevchenko, V. A. Mikhailov, and Yu. P. Zaval'skii. Translated from Zhur. Neorg. Khim., 3: 1955-8(1958).

The extraction capacities of several mono- and dialkyl phosphoric acids with regard to protactinium were examined. A mixture of alkyl phosphoric acids was obtained by interaction of the corresponding alcohol with anhydrous phosphorus pentoxide with a molar ratio $ROH : P_2O_5 = 4 : 1$. Pa^{233} was obtained by neutron irradiation of basic thorium carbonate and was freed from impurities. The extraction was carried out at room temperature by mechanical mixing of the phase in a separatory funnel. Alkyl phosphoric acids, and especially dialkyl phosphoric acids, were shown to be effective extracting agents for protactinium. On extraction by dialkyl phosphoric acids the distribution coefficients of protactinium were proportional to the square of the concentration of the extracting agent in the organic phase. (M.C.G.)

17626 (AEC-tr-4456(p.323-31)) STUDY OF THE EXTRACTION OF PROTACTINIUM BY MONO- AND DIISOAMYLPHOSPHORIC ACID. V. A. Mikhailov, V. B. Shevchenko, and V. A. Kolganov. Translated from Zhur. Neorg. Khim., 3: 1959-64(1958).

An investigation was made of the extraction of protactinium from nitric acid solutions by mono- and diisoamyl phosphoric acid. A possible mechanism of the extraction is discussed. The dependence of the distribution coefficient on the concentration of the extracting agent in the organic phase and on the concentration of H^+ and NO_3^- ions in the aqueous phase was determined. A probable reaction mechansim was suggested involving the formation of strongly hydrolyzed complex compounds from protactinium and the extracting agent in the aqueous phase and the passage of protactinium into the organic phase in the form of protactinium attached to five isoamyl phosphoric acid radicals. (M.C.G.)

17627 (AEC-tr-4456(p.332-4)) EXTRACTION OF URANYL PERCHLORATE WITH TRIBUTYL PHOSPHATE. V. B. Shevchenko, A. S. Solovkin, and I. V. Shilin. Translated from Zhur. Neorg. Khim., 3: 1965-7(1958).

The distribution of water and uranyl perchlorate in a 1.2M solution of TBP in CCl_4 was investigated as a function of the concentration of the salt in the aqueous phase. On the basis of experimental data it was assumed that uranyl perchlorate is extracted by TBP as $UO_2(ClO_4)_2 \cdot 2H_2O \cdot 2TBP$. (auth)

17628 (AEC-tr-4456(p.335-6)) PREPARATION OF THE CALCIUM SALT OF URANYL SUCCINATE. A. B. Bekturov and A. K. Il'yasova. Translated from Zhur. Neorg. Khim., 3: 1967-8(1958).

A compound of the composition $CaUO_2(C_4H_4O_4)_2 \cdot 3H_2O$ was obtained by dissolving calcium uranate in an excess of saturated aqueous solutions of succinic acid. The salt was separated in the form of large yellow prismatic crystals. Under the microscope, the crystals were seen to be rectangular plates. On heating to 900 to 1000°C, the nonvolatile residue was a yellow powder of calcium uranate. (M.C.G.)

17629 (AEC-tr-4456(p.341-2)) DETERMINATION OF THE RELATIVE VOLATILITY OF THE PRODUCTS OF INTERACTION OF $ZrCl_4$ AND $HfCl_4$ WITH $POCl_3$. G. A. Yagodin, G. S. Fomin, and L. A. Nisel'son. Translated from Zhur. Neorg. Khim., 3: 1971-2(1958).

The value of the relative volatility of the products of interaction of $ZrCl_4$ and $HfCl_4$ with $POCl_3$ was determined with the use of a recirculation apparatus equivalent to one theoretical plate. The time required for establishing equilibrium between the vapor and liquid phases was determined by the attainment of a constant value of relative volatility which was found to be 1.160 ± 0.005. (M.C.G.)

17630 (AEC-tr-4459) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhurnal Neorganicheskoi Khimii, 3: No. 11, 2433-2592(1958). 224p. (PST-Cat.-381)

A cover-to-cover translation of Zhurnal Neorganicheskoi Khimii (Journal of Inorganic Chemistry), Vol. 3, No. 11 is presented. Separate abstracts were prepared for 8 papers. One was previously abstracted for NSA. (M.C.G.)

17631 (AEC-tr-4459(p.6-17)) THE LOWER OXIDES OF NIOBIUM. S. I. Alyamovskii, G. P. Shveikin, and P. V. Gel'd. Translated from Zhur. Neorg. Khim., 3: 2437-44 (1958).

An x-ray study was made of the phase components of the system Nb–O, obtained by reduction of Nb_2O_5 with metallic niobium and carbon at 1200 and 1580 to 1650°C. It was found that the phases Nb_2O_5, NbO_2, NbO, and Nb exist in the system at these temperatures. It was established that an oxide having a face-centered cubic lattice with six ions in the elementary cell can exist in equilibrium both with the metal and its dioxide. The lattice constant was 4.2013 kX. In the high-temperature products of the interaction of niobium pentoxide with niobium and carbon, neither low oxides (Nb_2O, Nb_4O) nor the compounds Nb_3O_7, Nb_3O_5, Nb_2O_3, and Nb_3O_4 were detected. (auth)

17632 (AEC-tr-4459(p.18-24)) THERMODYNAMICAL STUDY OF THE REDUCTION OF BERYLLIUM OXIDE BY CARBON. M. V. Smirnov and N. Ya. Chukreev. Translated from Zhur. Neorg. Khim., 3: 2445-9(1958).

This paper was previously abstracted from a French translation (CEA-tr-R-1079) and appears in NSA, Vol. 15, abstract no. 11473.

17633 (AEC-tr-4459(p.50-6)) STUDIES ON THE EXTRACTION OF RUTHENIUM NITROSOTRINITRATE WITH TRIBUTYL PHOSPHATE. V. D. Nikol'skii and V. S. Shmidt. Translated from Zhur. Neorg. Khim., 3: 2467-71 (1958).

The dependence of the distribution coefficient of ruthenium nitrosotrinitrate on the concentration of TBP in the hydrocarbon diluent showed that the extracted compound is a solvate of $RuNO(NO_3)_3$ with 2 molecules of TBP. Increasing the acidity of the aqueous phase above 0.2N HNO_3, caused a considerable decrease in the distribution coefficient of ruthenium, due to displacement of $RuNO(NO_3)_3$ from the organic phase by HNO_3. The ionization constant of the aquo-acid $[RuNO(NO_3)_3(H_2O)_2]$ was calculated. (auth)

17634 (AEC-tr-4459(p.77-82)) THE NATURE OF HYDROCHLORIC ACID SOLUTIONS OF PENTAVALENT

NIOBIUM. S. I. Solov'ev and E. I. Krylov. Translated from Zhur. Neorg. Khim., 3: 2487-90(1958).

The state of niobium in HCl solutions was studied by dialysis, electric conductivity, and viscosity. It was found that a solution of niobium oxychloride in HCl does not pass through parchment membranes. Niobium oxychloride was progressively transformed into a gel of niobic acid during the process of dialysis. It was found that the gel of niobic acid is irreversible and exhibits thixotropic properties. The sign of the charge of the colloid particle and the ζ-electrokinetic potential for the sol of niobic acid were determined. (M.C.G.)

17635 (AEC-tr-4459(p.92-103)) CERTAIN PROPERTIES OF COMPLEX ACIDS FORMED BY RARE-EARTH ELEMENTS WITH ETHYLENEDIAMINETETRAACETIC ACID. N. D. Mitrofanova, L. I. Martynenko, and G. K. Eremin. Translated from Zhur. Neorg. Khim., 3: 2496-2505(1958).

The hydrate compositions of a number of rare-earth complex acids with ethylenediamine tetraacetic acid were determined along with their solubilities. Tentative conclusions were drawn regarding the structure of these complex acids. The compounds showed various degrees of hydration and solubilities depending on the conditions of synthesis. The cerium group of elements formed, at low temperatures, hydrated complex acids having a whole number of water molecules. Yttrium group elements also formed, at various temperatures, hydrates of varying composition which most often had a fractional number of water molecules. (M.C.G.)

17636 (AEC-tr-4459(p.104-12)) II. POLAROGRAPHIC INVESTIGATIONS OF SALTS OF RARE-EARTH ELEMENTS AND THEIR SYSTEMS WITH SOME COMPLEX-FORMING AGENTS. N. A. Kostromina and S. I. Yakubson. Translated from Zhur. Neorg. Khim., 3: 2506-11(1958).

The half-wave potentials, the i_1/c values, and the slopes of the logarithmic straight lines of ytterbium chloride solutions were determined. The heights of the waves of the limiting current of the ytterbium cation were compared with values for other rare earth elements. The polarographic behavior of the solutions of chlorides and sulfates of lanthanum and cerium in HCl and H_2SO_4, respectively, was studied. The polarographic method was used to study the phenomena of complex formation in solutions of ytterbium chloride with sodium lactate, gluconate, tartrate, and citrate as complex-forming agents. It was found that at concentrations up to 0.1M the reduction is a reversible one-electron process, while at higher concentrations the reduction is irreversible. The values of the ratios of the dissociation constants of the complexes Yb(III) and Yb(II) are presented. (auth)

17637 (AEC-tr-4459(p.113-27)) STUDIES ON THE HYDROLYSIS AND DECOMPOSITION OF THE SALT $Na_4UO_5 \cdot 9H_2O$ IN DILUTE SOLUTIONS. A. M. Gurevich and L. D. Preobrazhenskaya. Translated from Zhur. Neorg. Khim., 3: 2512-22(1958).

A physicochemical investigation of equilibria in dilute solutions of $Na_4UO_5 \cdot 9H_2O$ was carried out. The mechanism of hydrolysis and decomposition of Na_4UO_5 at a 1×10^{-3}M uranium concentration within the pH range of 4.0 to 14.0 was studied. Conditions were found for the existence of the nonhydrolyzed anion $[UO_5 \cdot nH_2O]^{4-}$ and of products of its hydrolysis and decomposition, among which a series of compounds having the following simplest formulas were identified in solution: Na_4UO_5, Na_3HUO_5, Na_2UO_5, $Na_2U_2O_9$, $NaHU_2O_9$, $H_2U_2O_9$, and $Na_2U_2O_7$. It was established that in aqueous solutions of Na_4UO_5 at a 1×10^{-3}M uranium concentration, the reversible reaction of the first stage of hydrolysis goes to completion: $UO_5^{4-} + H_2O \rightleftharpoons HUO_5^{3-} + OH^-$. The dissociation constants and hydrolysis constants were determined. (M.C.G.)

17638 (AEC-tr-4459(p.181-90)) THE PHASE DIAGRAM OF THE SYSTEM $NaF-BeF_2$. A. V. Novoselova, M. E. Levina, and M. P. Savel'eva. Translated from Zhur. Neorg. Khim., 3: 2562-70(1958).

The thermal analysis of the system $NaF-BeF_2$ was carried out and the phase diagram was constructed. The following double salts were found in the system: $3NaF \cdot BeF_2$ (decomposes above 480°C); $2NaF \cdot BeF_2$ (or Na_2BeF_4) (melts at 610°C); $NaF \cdot BeF_2$ (or $NaBeF_3$) (melts at 380°C); and $NaF \cdot 2BeF_2$ (decomposes above 270°C). Alloys in the region of the diagram in which BeF_2 crystallizes were found to melt twice. The quartz-like BeF_2 melted at 590°C. The high-temperature modification of BeF_2 melted at about 800°C. (auth)

17639 (AEC-tr-4459(p.206-20)) THE MECHANISM OF COPRECIPITATION OF MICROQUANTITIES OF CESIUM WITH PRUSSIAN BLUE. M. Kyrsh and O. E. Zvyagintsev. Translated from Zhur. Neorg. Khim., 3: 2582-92(1958).

Experimental data obtained on the effect of various conditions on cesium coprecipitation with Prussian blue (ferric ferrocyanide) led to the conclusion that it proceeds by anomalous mixed crystal formation with no lower limit of miscibility. It was found that this coprecipitation may be used for isolating cesium from dilute solutions. (M.C.G.)

17640 (AEC-tr-5027) THE SEPARATION OF METALLIC ELEMENTS BY ANION EXCHANGE RESINS. I. STUDY OF THE FIXATION OF SOME COMPLEX CHLORIDES. Bernard Trémillon (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Translated from report CEA-1942. 1961. 20p.

Also published, in French, in Bull. soc. chim. France, 275-81(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 27610.

17641 (AEC-tr-5087) FLUORINE-CONTAINING COMPLEXES. III. ZIRCONIUM TETRAFLUORIDE HYDRATE, ZIRCONIUM HYDROXYFLUORIDE AND THEIR CONDENSATION PRODUCTS. L. Kolditz and A. Feltz. Translated by L. M. Ferris (Oak Ridge National Lab., Tenn.) from Z. anorg. u. allgem. Chem., 310: 217-24(1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 178.

17642 (AEC-tr-5088) FLUORINE-CONTAINING COMPLEXES. II. THE HYDROLYSIS OF FLUOROZIRCONATES AND CONDENSATION OF THE HYDROLYSIS PRODUCTS. L. Kolditz and A. Feltz. Translated by L. M. Ferris (Oak Ridge National Lab., Tenn.) from Z. anorg. u. allgem. Chem., 310: 204-16(1961). 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 177.

17643 (FTD-TT-62-297) THE EMISSION OF POSITIVE MOLECULAR IONS FROM HEATED SURFACES IN A VACUUM. E. Ya. Zandberg and N. I. Ionov. Translated from Doklady Akad. Nauk S.S.S.R., 141: 139-42(1961). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 6401.

17644 SPECIFIC GRAVITY AS A FUNCTION OF NUCLEON NUMBER. J. Benko. Acta Chim. Acad. Sci. Hung., 29: 148-56(1961). (In German)

The quotient of atomic volume and of the square root of

atomic number yields values adjacent to each other at the elements of the same column of the long period system. Certain correlation exists between these quotients and the maximum valencies (numbers of valency electrons) characteristic of the single columns of the table. On this basis, equations were derived which proved to be suitable for the calculation of specific gravities of elements pertaining to various groups at a more or less accurate approximation. Each of the three main factors determining specific gravity and included with the derived equations appears to be based on the number of protons and neutrons forming the atomic nucleus. Namely, their combined sum, the nucleon number yields the atomic weight while the proton number itself determines the distribution of electrons in the single shells and also the number of valency electrons. (auth)

17645 CRYSTALLOGRAPHIC DATA FOR ORTHORHOMBIC URANIUM(IV) METAPHOSPHATE AND PLUTONIUM(IV) METAPHOSPHATE. Robert M. Douglass (Los Alamos Scientific Lab., N. Mex.). Acta Cryst., 15: 505-6(May 10, 1962).

Crystal morphology, x-ray diffraction data, and optical properties are tabulated. (P.C.H.)

17646 ELECTROCHEMICAL REDUCTION OF URANIUM(VI) TO URANIUM(IV) IN CARBONATE SOLUTIONS. V. Pravdić, M. Branica, and Z. Pučar (Institute "Ruder Bošković," Zagreb). Croat. Chem. Acta, 33: No. 3, 151-3(1961). (In English)

Cathodic reduction of U(VI) was carried out in aqueous 1M $NaHCO_3$ + 0.05M Na_2CO_3 (pH 8.7) at controlled potentials of −1.20 V vs SCE. U(IV) was obtained with a current efficiency of 95%. Precipitation of U(IV) at pH 10.7 with NaOH yielded $UO_{2.01}$. (auth)

17647 A LOOK AT LITHIUM COMPOUNDS. Ind. Eng. Chem., 54: 50-2(June 1962).

A brief review is given on the properties and uses of lithium compounds such as butyllithium, lithium hydride, and lithium nitride. The increase use of stereospecific polymerization catalysts focuses attention on lithium and its compounds. (P.C.H.)

17648 THE POSSIBILITY OF DETERMINING THE DEGREE OF OXIDATION OF URANIUM FROM THE EMISSION X-RAY SPECTRUM. K. I. Narbutt and I. P. Laputina. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 409-11(Mar. 1962). (In Russian)

A long wavelength x-ray fluorescent spectrometer was modified to remove the sample heat and to increase the radiation output by a factor of about 100. Cr radiation was used from a x-ray operating at 20 kV and 40 mA. A bent quartz disk was used as an analyzer. A gas counter with a thin (20 μ) window was used to determine the radiation. Preliminary measurements on the pure oxides UO_2, UO_3, and U_3O_8 showed that the last emission lines in the M_V spectrum were the most sensitive to changes in chemical bonding. These lines are due to electron transitions from a filled level of uranium in a lattice to the lower lying M_V level. The wavelengths of the transitions are about 3.5 Å. The greatest difference in line intensity is observed in the interval between M_Y (3.473 Å) and the lines for the N_{IV} to M_{III} transition (3.514 Å). The ratio of the areas of the emission bands in this region was found to be 1.6 for the oxides UO_3 and UO_2, and $^6/_4$ = 1.5 is the ratio of valences in these oxides. The shortest wavelength edge of the emission band in quadrivalent uranium is shifted to the side of lower energies by 2 ev. The pure uranium oxides can be distinguished by this method, but the phenomena are still too complex to follow the degree of oxidation in natural uranium oxides. (TTT)

17649 ABSOLUTE ISOTOPIC ABUNDANCE RATIO AND THE ATOMIC WEIGHT OF CHLORINE. William R. Shields, Thomas J. Murphy, Ernest L. Garner, and Vernon H. Dibeler (National Bureau of Standards, Washington, D. C.). J. Am. Chem. Soc., 84: 1519-22(May 5, 1962).

An absolute value was obtained for the isotopic abundance ratio of natural chlorine by surface emission mass spectrometry and by the use of calibration samples of known isotopic composition prepared from nearly pure separated chlorine isotopes. Mass spectrometric data obtained on two instruments result in an absolute value for the ratio, $Cl^{35}/Cl^{37} = 3.1272^{+0.0010}_{-0.0012}$. The calculated atomic weight of chlorine on the recently proposed unified physical and chemical atomic weight scale ($C^{12} = 12$) is $35.45273^{+0.00022}_{-0.00037}$. The indicated uncertainties are over-all limits of error based on 95% confidence limits for the mean and on allowances for effects of known sources of possible systematic error. Mass spectrometric determinations of the atomic weights of chlorine and silver give a combining weight ratio, Cl/Ag = 0.328667. (auth)

17650 THE EVALUATION OF THERMODYNAMIC ASSOCIATION CONSTANTS IN SOLUTIONS WITH AN APPLICATION TO MOLTEN SALT SOLUTIONS. J. Braunstein, M. Blander, and R. M. Lindgren (Oak Ridge National Lab., Tenn. and Univ. of Maine, Orono). J. Am. Chem. Soc., 84: 1529-33(May 5, 1962).

The evaluation of thermodynamic association constants in solution is discussed and is applied to molten salt systems. The calculated association constants K_1, K_2, and K_{12} for the formation of the species AgCl, $AgCl_2^-$, and Ag_2Cl^+, in molten KNO_3 at 385° are 460 ± 15, 169 ± 20, and 20 ± 10 (moles/mole KNO_3)$^{-1}$, respectively. A recalculation of the association constants, K_1, for the species $CdCl^+$ and $PbCl^+$ from cryoscopic, polarographic and from solubility data in nitrate melts incidates that the greater part of the very large discrepancies in the published values of K_1 is a result of the incorrect analysis of the data. (auth)

17651 THE ASSOCIATION OF CADMIUM ION WITH BROMIDE AND IODIDE IONS IN MOLTEN EQUIMOLAR $NaNO_3$−KNO_3. J. Braunstein and R. M. Lindgren (Univ. of Maine, Orono and Oak Ridge National Lab., Tenn.). J. Am. Chem. Soc., 84: 1534-8(May 5, 1962).

The activity coefficients of alkali bromide at 240 and 300° and of alkali iodide at 240 and 290° in dilute solutions of alkali halide and cadmium nitrate in molten equimolar mixtures of $NaNO_3$ and KNO_3 were determined from measurements of the electromotive force of the concentration cells with silver−solid silver halide electrodes Ag, AgX(s)|NaX−KX, $NaNO_3$-KNO_3||$NaNO_3$-KNO_3, $Cd(NO_3)_2$, NaX−KX|AgX(s), Ag. The thermodynamic association constants for the formation of $CdBr^+$ are 1520 and 990 (moles/mole solvent)$^{-1}$ at 240, and 300°, respectively. The association constants for the formation of CdI^+ are 5330 and 3130 (moles/mole solvent)$^{-1}$, respectively. The estimated error of the association constants is 5%. No evidence of polynuclear species was found in either case. The stepwise association constants for the formation of CdI_2 and $CdBr_2$ also were evaluated and the results were compared with the quasi-lattice model. (auth)

17652 THERMODYNAMIC ASSOCIATION CONSTANTS OF SILVER IONS WITH BROMIDE OR IODIDE IONS IN MOLTEN POTASSIUM NITRATE AND THEIR COMPARISON WITH THE QUASI-LATTICE THEORY. A. Alvarez-Funes, J. Braunstein, and M. Blander (Oak Ridge National Lab., Tenn. and Univ. of Maine, Orono). J. Am. Chem. Soc., 84: 1538-42(May 5, 1962).

Electromotive force measurements in dilute solutions

of Ag^+ and Br^- in molten KNO_3 at 403, 438, 452, 474, and 500° and Ag^+ and I^- in molten KNO_3 at 402° were used to evaluate the association constants K_1, K_2, and K_{12} for the formation of AgX, AgX_2^-, and Ag_2X^+, respectively, where X = Br or I. The comparison of the values of K_1 in the bromide containing system with the theoretical calculations based on the quasi-lattice model demonstrated that the temperature coefficients of the K_1 are correctly predicted by the theory for any reasonable choice of the coördination number using values of the specific bond free energies ΔA_1, which are independent of temperature. For Z = 5 average values of ΔA_1, ΔA_2, and ΔA_{12} are 7.14, 7.0, and 6.7 kcal/mole, respectively. The values of the specific bond free energies for the formation of the ion pairs Ag^+-Cl^-, Ag^+-Br^-, and Ag^+-I^- in KNO_3 for Z = 5 are 5.8, 7.1, and 9.3 kcal/mole, respectively. (auth)

17653 SECONDARY HYDROGEN ISOTOPES EFFECTS. IV. SOLVOLYSIS RATES OF SPECIFICALLY DEUTERIUM LABELED CYCLOPROPYLMETHYL BENZENESULFONATES. Stanko Borčić, Marija Nikoletić, and Dionis E. Sunko ("Rudjer Bošković" Inst., Zagreb). J. Am. Chem. Soc., 84: 1615-21(May 5, 1962).

The synthesis of cyclopropylmethyl-1,1-d_2, -2-d, -3,3-d_2, and -3,3,4,4-d_4 benzenesulfonates is described. Acetolysis and ethanolysis rates were measured and it was found that the first two compounds solvolyze more slowly and the last two more rapidly than the undeuterated analogs. It was also found that the isotope effects are more pronounced in ethanolysis and that the rate increase per atom deuterium is larger with the dideuterated than with the tetradeuterated compound. The results are discussed in terms of rehybridization, hyperconjugation, and induction and are found to be consistent with the solvolysis mechanism postulating the participation of the neighboring cyclopropyl group in the rate-determining step with the formation of a bicyclobutonium ion. (auth)

17654 PRIMARY AND SECONDARY DEUTERIUM ISOTOPE EFFECTS ON THE DEHYDRATION OF β-PHENYL-β-HYDROXYPROPIONIC ACID. Donald S. Noyce and Charles A. Lane (Univ. of California, Berkeley). J. Am. Chem. Soc., 84: 1641-4(May 5, 1962).

The kinetics of racemization of (+)-β-phenyl-β-hydroxypropionic-α-d_1 acid were determined. The secondary isotope effect in this reaction is 1.11 ± 0.02. The rate of dehydration of β-phenyl-β-hydroxypropionic-α-d_1 acid is markedly less than that of the analogous protium compound. It is concluded that the kinetic isotope effects support a mechanism in which the rate-determining step is the direct loss of the α-proton to give cinnamic acid. (auth)

17655 ISOTOPE EFFECTS IN THE ACID-CATALYZED ISOMERIZATION OF CINNAMIC ACIDS. Donald S. Noyce, Harvey S. Avarbock, and Wilmer L. Reed (Univ. of California, Berkeley). J. Am. Chem. Soc., 84: 1647-50(May 5, 1962).

The solvent isotope effect upon the rate of isomerization of cis-cinnamic acids is substantial. At 25° in 47% sulfuric acid k_{H_2O}/k_{D_2O} is 6 for the isomerization of cis-p-methoxycinnamic acid. The Gross-Butler equation is not followed when the deuterium content of the solvent is varied. A detailed mechanism for the isomerization of cis-cinnamic acids is presented, a mechanism involving direct proton addition to give a solvated carbonium ion. Since the reaction rate parallels H_0 with unit slope, the acidity function is not a useful criterion for rate-determining proton transfers. (auth)

17656 SOLVENT ISOTOPE EFFECTS IN CATALYZED HYDROLYSIS OF CARBOXYLIC ACID DERIVATIVES. S. L. Johnson (Mellon Inst., Pittsburgh). J. Am. Chem. Soc., 84: 1729-34(May 5, 1962).

Kinetic solvent isotope effects for N-methylimidazole and acetate catalysis of benzoic anhydride hydrolysis, and for N-methylimidazole and 4-methylpyridine catalysis of p-nitrophenyl acetate hydrolysis in light and heavy water were measured. The isotope effects for these reactions fall in the range 1.1 to 1.5, indicating that nucleophilic catalysis is operative. The two mechanistic possibilities for general base catalysis, the general base acting directly on a water molecule in the transition state or prior equilibrium of the ester with hydroxide ion and a general acid-assisted decomposition of the intermediate, are discussed. The latter mechanism is discarded for carboxylic acid derivatives with good leaving groups (phenyl esters and anhydrides). (auth)

17657 PROTON MAGNETIC RESONANCE STUDIES OF POLYCRYSTALLINE URANIUM OXIDE HYDRATES. I. β-$UO_2 2H_2O$. A. L. Porte (Univ. of Glasgow), H. S. Gutowsky, and J. E. Boggs. J. Chem. Phys., 36: 1695-9(Apr. 1, 1962).

The broad-line proton magnetic resonance spectra of polycrystalline samples of the compound formulated empirically as β-$UO_3 2H_2O$ were investigated in the temperature range 77–350°K. The second moment of the absorption spectrum at 77°K indicates that some of the protons in the crystal are not present in water of crystallization and an analysis of the line shape shows that the compound is the trihydrate of pyrouranic acid, $U_2O_5(OH)_2 \cdot 3H_2O$. The chemical properties of the compound are accounted for on the basis of this formula. (auth)

17658 PROTON MAGNETIC RESONANCE STUDIES OF POLYCRYSTALLINE URANIUM OXIDE HYDRATES. II. β-UO_3H_2O. A. L. Porte (Univ. of Glasgow), H. S. Gutowsky, and J. E. Boggs. J. Chem. Phys., 36: 1700-3(Apr. 1, 1962).

The broad-line proton magnetic resonance spectra of polycrystalline samples of the compound formualted empirically as β-UO_3H_2O were examined in the temperature range 77–370°K. Analysis of the spectrum at 77°K shows that the compound is uranyl hydroxide $UO_2(OH)_2$. The interrelationships between the different phases in the uranium trioxide–water system which involve the β-modifications of the uranium trioxide hydrates are discussed. (auth)

17659 ANALYSIS OF VALENCE-BOND WAVE FUNCTIONS FOR LiH. J. C. Browne (Univ. of Texas, Austin). J. Chem. Phys., 36: 1814-17(Apr. 1, 1962).

Several LiH valence-bond wave functions of nonorthogonal structure are analyzed in terms of the natural orbitals and the structure projections. The wave functions are shown to agree well among themselves and to be closely similar to molecular orbital wave functions which give similar total energies. (auth)

17660 GASEOUS DIFFUSION IN POROUS MEDIA. II. EFFECT OF PRESSURE GRADIENTS. R. B. Evans, III (Oak Ridge National Lab., Tenn.), G. M. Watson, and E. A. Mason. J. Chem. Phys., 36: 1894-1902(Apr. 1, 1962).

A previously proposed model for the diffusion of gases in porous media at uniform pressure is extended to allow for pressure gradients. The effect of pressure gradients is to introduce into the fundamental kinetic theory equations both a pressure diffusion term and an external force term, which is needed to keep the porous medium from being pushed along by the pressure gradient. There is a considerable cancellation of terms, and the final diffusion equation has the same form as in the uniform pressure case. No addi-

tional parameters beyond those necessary to define a diffusing system at uniform pressure are thus required to compute the diffusion rates when pressure gradients are present. The coefficients of the diffusion equation, however, now depend on position through their dependence on pressure, and the net flux J of all molecules is an undetermined quantity. A complete solution requires also a forced flow equation giving J as a function of the pressure gradient. Two forced flow equations, which were derived, are shown to be not inconsistent in viscous flow regimes, and to complement rather than contradict each other. Agreement of the calculations with available experimental data is good. As in the uniform pressure case, the Poiseuille flow equation does not give an a priori characterization of any porous medium, but rather permits prediction of the behavior of different gas mixtures under a variety of conditions on the basis of three parameters which can be obtained from only a few experimental measurements. (P.C.H.)

17661 OBSERVATIONS IN PROTON NMR SPECTRA OF LONG-RANGE COUPLING BETWEEN PROTONS AND CARBON-13 IN NATURAL ABUNDANCE. D. R. McAdams (Humble Oil and Refining Co., Baton Rouge, La.). J. Chem. Phys., 36: 1948-9(Apr. 1, 1962).

Observations of long-range coupling were made with an NMR spectrometer with sample spinning frequencies of about 35 cps. Resulting satellite peaks located from 2.5 to 5 cps on either side of the principal peak center were found to have amplitudes approaching ten times the effective noise level. The satellite amplitude has the same order of magnitude as that of the foot of the main peak at the location of the satellite. The cause of the satellites was established by a study of a variety of compounds including sodium acetate labeled with C^{13} in a carboxyl group. (P.C.H.)

17662 ISOTOPIC EXCHANGE BETWEEN GASEOUS HYDROGEN AND LIQUID AMMONIA. PART I. Kedma Bar-Eli and Fritz S. Klein (Chelsea Coll. of Science and Tech., London). J. Chem. Soc., 1378-88(Apr. 1962).

The isotopic exchange of gaseous hydrogen with liquid ammonia was studied by using deuterium hydride, tritium hydride, and deuterium. It is catalyzed by alkali amides. The dependence of its rate on the concentration and the type of the catalyst, on the exchanging hydrogen, and on the temperature was measured. Catalysis was found to be due to free amide ion and to undissociated alkali amide. The activation energy is 7.5 kcal/mole. The isotope effects found are analyzed and shown to be consistent with a two-step mechanism in which an intermediate complex, composed of a hydrogen, a catalyst, and a solvent molecule, participates. (auth)

17663 THE DISSOLUTION REACTION AND ATTACK OF BERYLLIUM BY HF, HCl, AND H_2SO_4. M. E. Straumanis and D. L. Mathis (Univ. of Missouri, Rolla). J. Electrochem. Soc., 109: 434-6(May 1962).

Beryllium reactions with the three acids, which are expected to react as follows: $Be + 2HF \rightarrow BeF_2 + H_2$, $Be + 2HCl \rightarrow BeCl_2 + H_2$, and $Be + H_2SO_4 \rightarrow BeSO_4 + H_2$, were checked by dissolving a weighed amount of the metal in the acids and measuring the volume of hydrogen evolved. Although the quantitative reactions were quite similar, the attack of the metallic surface by HCl differed from that by the other two acids. A polished surface of Be, subjected to the action of HF or H_2SO_4 remained smooth, as if polished, even after a longer etching time. However, high magnifications revealed some structure. Contrary to this, the reaction with HCl (about 0.5N) was strongly localized since the structure of the metal appeared clearly with striations across the grains. When Be was dissolved in HCl at concentrations lower than 0.5N, a black deposit covered the metal which then separated from the latter and turned the whole solution black. No formation of a black deposit was observed in concentrations higher than 0.5N HCl and no blackening of the acids could be observed in any concentration of HF and H_2SO_4. However, formation of a black deposit and hence, disintegration of Be was also observed in $HClO_4$ at about 0.3N and in HBr at about 1N. (P.C.H.)

17664 CHEMISTRY OF THORIUM. PART II. AMINO DERIVATIVES OF THORIUM TETRACHLORIDE. Sarju Prasad and Suresh Kumar (Banaras Hindu Univ., India). J. Indian Chem. Soc., 39: 15-16(Jan. 1962). (In English)

Amino derivatives of thorium (IV) chloride were prepared by the action of $ThCl_4$ on some aromatic secondary and tertiary amines and heterocyclic bases. The properties of the compounds were studied and discussion is given on their structures. (auth)

17665 SOME OBSERVATIONS ON THE URANIUM–NIOBIUM–HYDROGEN SYSTEM. O. M. Katz and E. A. Gulbransen (Westinghouse Research Labs., Pittsburgh). J. Nuclear Materials, 5: 269-79(Apr. 1962). (In English)

The reaction of body-centered-cubic gamma phase U + 10 wt % Nb and U + 90 wt % Nb with hydrogen was investigated below one atmosphere of pressure between 264° and 571°C. Dissociation pressure hysteresis was found in the 264°C isotherm for the U + 10 wt % Nb alloy, but did not exist at 299°C. The maximum composition reached at 264°C was $U\,Nb_{0.367}H_{1.363}$. Even though UO_2 was present on the sample, it was felt that the hysteresis was an intrinsic property of the metal lattice. The formation of a reaction product on quenching in U + 10 wt % Nb–H alloys indicated a low temperature phase which could have formed by a martensitic mechanism. No hysteresis was found in the equilibrium isotherms for U + 90 wt % Nb–H alloys. The relative partial molar enthalpies and entropies decreased from a mole ratio, $n_H/n_U + n_{Nb}$, of 0.04 to 0.40 and then increased to $n_H/n_U + n_{Nb} = 0.575$. Relative partial molar free energies increased with increasing composition at a given temperature and increasing temperature at a given composition. A given percentage of hydrogen was less stable in a U + 90 wt % Nb alloy than in pure Nb. (auth)

17666 COÖRDINATION COMPOUNDS. III. CHELATE COMPOUNDS OF THE URANYL ION WITH HYDROXY, MERCAPTO, AND AMINO ACIDS. Michael Cefola, Robert C. Taylor, Philip S. Gentile, and A. V. Celiano (Fordham Univ., New York). J. Phys.,Chem., 66: 790-1 (May 1962).

A potentiometric study was made of the chelates formed by the uranyl ion with the amino, hydroxy, and mercapto analogs of acetic, propionic, and succinic acids. The order of decreasing stability was aspartic, β-alanine, glycine, malic, thiomalic, β-hydroxypropionic, glycolic, and thioglycolic acids. The stability of chelates with analogs of acetic, propionic, and succinic acids decreases for any given acid as the donor group changes from NH_2 to OH to SH. This decrease parallels the order of decreasing basicity in any given series. Considering acids which contain the same donor group (NH_2, OH, or SH) decreasing stability is observed in the analogs of succinic, propionic, and acetic acids, in that order. (auth)

17667 HIGH TEMPERATURE ADSORPTION STUDIES ON VARIOUS ION-EXCHANGED FORMS OF ZEOLITES A AND X. P. E. Eberly, Jr. (Humble Oil & Refining Co., Baton Rouge, La.). J. Phys. Chem., 66: 812-16(May 1962).

Pulse flow techniques were used to measure the heats of adsorption of benzene and n-hexane on various ion-exchanged forms of zeolite X at 260–482°. The monovalent materials (Li^+, Na^+, and K^+) gave values of about 16.0 and 12.0 kcal/mole for benzene and n-hexane, respectively. Considerable variation was observed in benzene heats of adsorption on the divalent ion-exchanged forms. The Mg^{2+} Ca^{2+}, Zn^{2+}, Sr^{2+}, Cd^{2+}, and Ba^{2+} forms of zeolite X exhibited 11.6, 21.8, 11.2, 23.3, 24.0, and 10.0 kcal/mole for benzene, respectively. Similar data were obtained with hexene-1 and n-hexane on several divalent ion-exchanged forms of zeolite A. Cadmium zeolite A gave the highest heat of adsorption of hexene-1, which amounted to 21.5 kcal/mole. This compares to 16.4 kcal/mole observed on calcium zeolite A. (auth)

17668 OXIDE-COATED ELECTRODES. I. ALUMINUM IN ACID SOLUTIONS. Robert C. Plumb (Worcester Polytechnic Inst., Mass.). J. Phys. Chem., 66: 866-70(May 1962).

An investigation of the electrode potentials of aluminum as a function of the oxide thickness and the nature of the electrolyte is reported. A specially designed apparatus for producing variably oxidized surfaces and precluding the effects of oxidation in solution by observing the potentials as transients was used. Knowing the nature of the effect of the oxide film permits the potentials of oxide-free surfaces to be obtained. Using an appropriate model for the electrode reaction, values for the free energy of formation of aluminum ions and the solubility of undissociated aluminic acid which are in substantial agreement with and probably somewhat better than previously accepted values, are obtained. (auth)

17669 ARSENIC(III)–ARSENIC(V) EXCHANGE REACTION IN HCl SOLUTIONS. Lewis L. Anderson and Milton Kahn (Univ. of New Mexico, Albuquerque). J. Phys. Chem., 66: 886-9(May 1962).

A measurable exchange was observed between As(III) and As(V) in 10.8 to 12.6 *f* HCl at 29.7°, and in 10.9 *f* HCl at 48.6 and 67.3°. Complex exchange curves were observed at each temperature. The complexity is attributed to the slow interconversion, via hydrolytic reactions, among two or more forms of As(V) which exchange at different rates with As(III). Spectrophotometric studies revealed that As(V) species in 10.9 *f* HCl were not in chemical equilibrium even after 19.3 days of aging at room temperature. There is spectrophotometric evidence for the existence of polymeric forms of As(V) in 10.9 *f* HCl. (auth)

17670 CONDUCTANCE OF THE ALKALI HALIDES. III. THE ISOTOPIC LITHIUM CHLORIDES. Robert W. Kunze and Raymond M. Fuoss (Yale Univ., New Haven). J. Phys. Chem., 66: 930-6(May 1962).

Conductances of the chlorides of Li^6 and Li^7 in water at 25° were measured over the concentration range 0.002–0.01 N. The limiting conductances are $\Lambda_0(Li^6Cl) = 115.23$ and $\Lambda_0(Li^7Cl) = 115.10$. The difference of 0.13 (6 times experimental error) corresponds to a 0.35% greater mobility for the ion of Li^6. (auth)

17671 A TECHNIQUE FOR THE RAPID DETERMINATION OF IONIZATION AND APPEARANCE POTENTIALS. Robert W. Kiser and Emilio J. Gallegos (Kansas State Univ., Manhattan). J. Phys. Chem., 66: 947-8(May 1962).

A method of obtaining approximate ionization and appearance potentials using a Bendix time-of-flight mass spectrometer was developed. Using this method, which is called the energy compensation technique, ionization and appearance potentials may be obtained usually in less than one minute. The method, being instrumental in character, eliminates the necessity of obtaining the usual ionization efficiency curve. Some results of ionization potentials determined for various compounds using the linear extrapolation method, logarithmic plot method, extrapolated voltages difference method, and the energy compensation method are tabulated. (P.C.H.)

17672 THE IONIZATION POTENTIALS OF CYCLOPROPYL RADICAL AND CYCLOPROPYL CYANIDE. Robert W. Kiser and Brice G. Hobrock (Kansas State Univ., Manhattan). J. Phys. Chem., 66: 957-8(May 1962).

The ionization potential of the cyclopropyl radical was calculated to be 7.8 ± 0.4 ev and for cyclopropyl cyanide to be 11.2 ± 0.2 ev. Heats of formation of the various gaseous ions were calculated as $\Delta H_f + (C_3H_5CN) = 301$, $\Delta H_f + (C_3H_4CN) = 298$, $\Delta H_f(C_3H_3) = 68$, and $\Delta H_f + (C_3H_3) = 246$ kcal/mole. Reasons are given for the contention that C_3H_3 is the cyclopropyl rather than allyl radical. (P.C.H.)

17673 CAESIUM–SODIUM ION EXCHANGE ON CLINOPTILOLITE. Galen R. Frysinger (Arthur D. Little, Inc., Cambridge, Mass.). Nature, 194: 351-3(Apr. 28, 1962).

Clinoptilolite is a natural zeolite that has a high selectivity for Cs. The sorption of Cs and Na ions on clinoptilolite is determined, and exchange sorption isotherms are determined for Cs–Na exchange on clinoptilolite at 50 and 75°C. (T.F.H.)

17674 EVIDENCE OF THE INFLUENCE OF DEFECTS ON SZILARD-CHALMERS PROCESS. T. Andersen and A. G. Maddock (University Chemical Lab., Cambridge, Eng.). Nature, 194: 371-2(Apr. 28, 1962).

Small amounts of Ca are added to potassium chromate crystals, and the efficiencies of the Ca-doped and pure crystals as Szilard-Chalmers targets are compared. The thermal annealing characteristics of these crystals are also compared. After annealing for about 6 hr, further annealing takes place very slowly. Samples annealed for 16 hr are crushed, which caused a rapid rise in the annealing rate that again tapers off to a very small value. (T.F.H.)

17675 RHENIUM HEXACHLORIDE. R. Colton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 194: 374-5(Apr. 28, 1962).

$ReCl_6$ is produced by the direct action of Cl_2 gas on Re metal at 600°C. The hydrolysis, oxidation, thermal stability, and crystalline characteristics of $ReCl_6$ are described. (T.F.H.)

17676 GRAPHITIZATION OF EVAPORATED CARBON. Tokiti Noda (Nagoya Univ., Japan), and Hiroshi Matuoka. Nippon Kagaku Zasshi, 64: 2083-7(Dec. 1961). (In Japanese)

Pure carbon deposits were prepared by the evaporation of graphite of atomic reactor grade in a vacuum furnace and were heat-treated at temperatures between 2000 and 3000°C either in vacuo or under the atmospheric pressure. The lattice constants, crystal size, and orientation of graphite crystallites in the heat-treated carbons were measured by the x-ray diffraction method. The specimens were also observed under an electron microscope. The original evaporated carbon was nearly amorphous and had the turbostratic structure of relatively large graphite-like layers. The degree of graphitization of the carbons increased rapidly from 2000 to 2500°C and gradually above 2500°C up to 3000°C as in the case of graphitizing petroleum coke, while with the heat-treatment in vacuo the degree of graphitization changed slightly up to 2500°C and the graphitization took place only at temperatures higher than 2500°C. The degree of graphitization of carbons

treated at about 3000°C in vacuo was found to be almost equal to that of the carbons treated at the same temperature under the atmospheric pressure. The crystallite size of the carbons changed almost parallel with the change of the lattice constant c_0. The orientation of graphite crystallites parallel to the evaporated surface of the carbons increased with the heat treatment of the carbons. The effect of gas pressure on the graphitization and the change of the preferred orientation of crystallites in the carbons with the heat-treatment suggest that the process of atomic migration is one of the main factors of the graphitization process along with the translation and rotation of graphite-like layers of carbons and the coalescence of the layers. (auth)

17677 RANDOM MOTION OF DEUTERONS IN KD_2PO_4. V. Hugo Schmidt and Edwin A. Uehling (Univ. of Washington, Seattle). Phys. Rev., 126: 447-57(Apr. 15, 1962).

Magnetic resonance studies of the deuteron in KD_2PO_4 show the existence of deuteron jumping between and within hydrogen bonds. The experimental results aid in the analysis of electrical conductivity and ferroelectric phenomena in crystals of this type. Pulse magnetic resonance experiments show that the lifetime T_{XY} against deuteron jumping between X- and Y-oriented hydrogen bonds is 15 msec at 70°C, with a jump activation energy of approximately 0.58 ev. The c-axis electrical conductivity of KD_2PO_4 is found to have the same activation energy, with a value of 1.16×10^{-19} (ohm cm)$^{-1}$ at 25°C. The $\Delta m = 1(P_1)$ and $\Delta m = 2(P_2)$ deuteron spin-lattice relaxation transition probabilities arising in X-Y jumps are calculated from the known values of T_{XY} and the electric field gradient tensors at X and Y deuteron sites. There magnitudes and the dependences of these magnitudes on magnetic field, temperature, and orientation agree with experiment. Further measurements of P_1 and P_2 separately give a component of transition probability proportional to exp(0.078 ev/kT), independent of magnetic field. The orientation dependences of P_1 and P_2 for this component indicate quadrupolar relaxation due to deuteron jumps along hydrogen bonds, with a jump time of order 10^{-11} sec at 215°K. The existence of intrabond jumps governed by an activation energy is shown to be consistent with the theory of KH_2PO_4. (auth)

17678 NUCLEAR SPIN-LATTICE RELAXATION IN SOME FERROELECTRIC AMMONIUM SALTS. S. R. Miller, R. Blinc, M. Brenman, and J. S. Waugh (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 126: 528-32(Apr. 15, 1962).

The temperature dependence of H^1 and F^{19} spin-lattice relaxation times in polycrystalline $(NH_4)_2SO_4$, $(NH_4)_2BeF_4$, NH_4HSO_4, and $(NH_4)_3H_3IO_6$ are measured in both the ferroelectric and nonferroelectric phases, using a pulse technique at 30 Mc. The spin-lattice relaxation processes are found to be determined by molecular reorientation. Definite changes in the proton relaxation behavior in the neighborhood of the Curie points indicate a change in the state of internal motion at the transition. The same is found to be true for two solid solutions of $(NH_4)_2BeF_4$ in $(NH_4)_2SO_4$. The results suggest that the ferroelectric phase changes in these solids are in general accompanied by a change in lattice structure which alters the potential in which the nuclei move, but do not involve an important change in the degree to which nuclei must cooperate in order to surmount the potential barriers. (auth)

17679 THE $^1I_6$ STATE OF Pr^{3+} IN $LaCl_3$ AT 77°K. R. M. Agrawal, R. K. Asundi, R. C. Naik, D. Ramakrishnan, and Shobha Singh (Atomic Energy Establishment, Trombay, India). Proc. Indian Acad. Sci., Sec. A, 55: 106-112(Feb. 1962). (In English)

A single crystal of 5% Pr^{3+} in $LaCl_3$ was grown by Stockbarger's method and its absorption spectrum at 77°K at 4200 to 5400 Å on a grating spectrograph having a dispersion of 5 Å/mm in the first order. Polarization of the absorption lines was also obtained. In the group of lines arising from $^1I_6 \leftarrow {}^3H_4$ transition, six more lines in addition to the four previously known were observed. Analysis of all ten lines is given. One additional Stark level in $^1I_6$ is established at 21407 cm^{-1} with $\mu = 1$. For a few lines, the polarization results obtained do not agree with those of previous workers, but fit satisfactorily in the analysis. (auth)

17680 POLAROGRAPHIC FUSED SYSTEMS CONTAINING ZIRCONIUM COMPOUNDS. I. N. Sheiko, A. V. Gorodyskii, and V. V. Kuz'movich (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukrain. Khim. Zhur., 27: 767-70(1961). (In Russian)

Polarographic studies were made of fused K_2ZrF_6, $ZrCl_4$, and ZrO_2 in equimolar KCl · NaCl. Zirconium was separated following the first cathode process. Two forms of zirconium fluoride were observed in the melt. Both forms are expressed by two wave curves, while $ZrCl_4$ exhibits several waves. Zirconium oxides and fluorine form a soluble, easily reducible in a cathodic systems. (R.V.J.)

17681 STUDY OF THE RELATIVE STRENGTH OF CERTAIN COMPLEX COMPOUNDS OF NIOBIUM AND TANTALUM IN SOLUTION. A. K. Babko and V. V. Lukachina (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukrain. Khim. Zhur., 27: 794-6(1961). (In Russian)

The stability of Nb and Ta complexes in tartaric, citric, oxalic, lactic, and ethylenediaminetetra acetic acids and with sodium fluoride and pyrocatechin was analyzed. The minimum complexing agent concentrations for retaining Nb and Ta at pH 1.2, 2.5, and 5.0 were determined. It was found that an addition of one mole of citric, tartaric, oxalic, or ethylenediaminetetra acetic acid to several (up to 6) moles of Nb or Ta solution results in polynuclear complexes. (R.V.J.)

17682 DIBORANE CHEMISTRY. B. M. Mikhailov (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Uspekhi Khim., 31: 417-51(Apr. 1962). (In Russian)

The structure and physical properties of diborane are described, and methods for preparing diborane, alkyldiborane, and aryl-diborane are discussed. The chemical properties of diborane and its alkyl- and aryl-derivatives are analyzed, and their reactions with nitrogen, sulfur, phosphorus, arsenic, and antimony compounds are studied. Studies are also made of boron halides and of diborane and tetramethyl boron reactions with metals. The reactions of diborane and its alkyl- and aryl-derivatives with indefinite compounds are also analyzed. 238 references are included. (R.V.J.)

17683 A STUDY OF THE PHYSICAL AND CHEMICAL PROPERTIES OF A NUMBER OF URANYL COMPOUNDS CONTAINING 1,10-PHENANTHROLINE AND 2,2'-DIPYRIDYL. V. P. Markov and V. V. Tsapkin (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 7: 490-7(Mar. 1962). (In Russian)

Absorption spectra are presented for 0.01 M $C_{10}H_8N_2$ in water, 0.1 M $UO_2Cl_2 \cdot 3H_2O$ in water and 0.01 M $UO_2Cl_2 \cdot C_{10}H_8N_2 \cdot H_2O$ in CH_3OH. Significant shifts in the spectra were observed. Thermogravimetric analyses of the complex compounds showed that the last molecule of water was strongly bound. The specific electrical conductivity was

determined for 0.001 to 0.009 molar series of UO_2Cl_2, $UO_2Cl_2 \cdot C_{10}H_8N_2$ and $C_{10}H_8N_2$. The data indicate that a reaction occurs between UO_2Cl_2 and $C_{10}H_8N_2$. The molar electrical conductivities are listed for 16 uranyl compounds. The data indicate the formation of a Werner series of complexes, and 17 coordination formulas are presented for compounds of this type. (TTT)

17684 A STUDY OF A NUMBER OF PROPERTIES OF URANYL COMPLEXES WITH THE SCHIFF BASES. I. A. Savich, A. K. Pikaev, V. G. Lebedev, E. U. Kuz'micheva, and Vikt. I. Spitsyn (Moscow State Univ.). Zhur. Neorg. Khim., 7: 498-509(Mar. 1962). (In Russian)

Schiff bases were synthesized by reacting an aromatic o-oxyaldehyde with a heterocyclic or aromatic amine. The schiff base and uranyl nitrate or acetate were refluxed 15 to 60 minutes in an alcoholic medium to form the uranyl schiff base complex. The compounds are poorly soluble in water or the usual organic solvents, but are soluble in absolute dioxane. A sharp increase in the molar absorption coefficient is observed as compared to that of the uranyl ion. Complexes with the azomethenyl group in the 2 position of the pyridine nucleus are the most stable. An electronographic study showed that these compounds are crystalline. Thirteen uranyl schiff base complexes were synthesized, and their properties are listed. (TTT)

17685 THE USE OF ELECTRICAL CONDUCTIVITY IN STUDYING THE INTERACTION BETWEEN COMPONENTS OF OXIDE SYSTEM. S. F. Pal'guev and Z. S. Volchenkova (Electrochemical Inst., Urank Branch of the Academy of Sciences, USSR). Zhur. Neorg. Khim., 7: 615-17(Mar. 1962). (In Russian)

Measurements of the variations in electrical conductivity as a function of composition is a sensitive method of detecting chemical reactions between oxide components and also structural changes such as the formation of various types of solid solutions. Since the electrical conductivity is also effected by other factors, it is advisable to employ supplementary data such as the degree of shrinkage on sintering in order to complement the electrical conductivity data. The electrical conductivity increases as long as the number of lattice defects is not too large, and begins to decrease when the interaction between defects is sufficiently great. Thus, maxima in the electrical conductivity are observed at 15 to 25 mol % metal oxide for systems in which solid solutions are formed such as ZrO_2-MgO, ZrO_2-CaO, CeO_2-MgO, CeO_2-CaO, CeO_2-SrO and CeO_2-ZrO_2-CaO. Structural changes observed in these systems by a change in electrical conductivity are corraborated by observations on the degree of shrinkage after sintering. (TTT)

17686 COMPOUNDS OF THE RARE EARTH ELEMENTS WITH DIBUTYL PHOSPHORIC ACID. Z. A. Sheka and E. E. Kriss. Zhur. Neorg. Khim., 7: 658-64 (Mar. 1962). (In Russian)

Definite volumes of a $Y(NO_3)_3$ solution of constant concentration were mixed with equal volumes of 1 M dibutylphosphoric acid (DBA) in CCl_4. The results show that a compound of the composition YA_3 is formed, where A stands for one molecule of DBA. The MA_3 formula was confirmed by isolating the compounds NdA_3 and YA_3 by precipitation, and by analyzing these compounds. The MA_3 compound is stable, but a weak complex $M(HA_2)_3$ forms in an excess of DBA. The logarithms of the equilibrium constants for the reaction $M^{3+} + 3HA + 3A^- = MA_3(HA)_3$ were found to be 15.0 for praseodymium, 15.4 for neodymium, and 18.6 for ytterbium. The equilibrium constant for the reaction $MA_3 + \frac{3}{2} H_2A_2 = MA_3(HA)_3$ was calculated to be 0.13 for ytterbium. (TTT)

17687 THE EXTRACTION OF A NUMBER OF STRONG, MONOBASIC ACIDS WITH TRIOCTYLAMINE. O. I. Zakharov-Nartisssov and A. V. Ochkin. Zhur. Neorg. Khim., 7: 665-70(Mar. 1962). (In Russian)

Equal volumes of acidic solution were contacted with a 0.225 M trioctylamine solution in CCl_4. The residual acid in the aqueous phase was titrated with caustic, and the free amine in the organic phase was determined by titration with perchloric acid in methyl alcohol with alizarin red as an indicator. The water in the organic phase was determined with Fisher's reagent. The equilibrium constants were found to be $\sim 2.0 \times 10^9$ for $HClO_4$, 1.15×10^9 for HNO_3, 7×10^5 for HBr and 3.5×10^4 for HCl. This decreasing order of extraction for the acids can be explained by energy effects involving hydration of the anion and the electrostatic interaction. In studying the hydration of $HClO_4$, HCl, HBr and HI, it was found that the degree of hydration decreases with increasing radius of the anion. With high concentrations of acid in the aqueous phase, the ratio of TOA to HA can exceed one, because of dissolution of acid in the organic phase. The dissolution of acid in the organic phase decreases with increasing acid strength. (TTT)

17688 THE REACTION OF CERIUM WITH HYPOCHLORITE COMPOUNDS. A. A. Ivakin. Zhur. Priklad. Khim., 35: 245-50(Feb. 1962). (In Russian)

Since oxidation of Ce(III) to Ce(IV) is important in separating Ce from rare earths, the mechanism of the reaction of $CeCl_3$ with NaOCl was followed by potentiometric titration. The changes in pH as a function of the mole ratio of NaOCl to $CeCl_3$, the active chlorine in the equilibrium solution and the content of cerium in the precipitate were all determined and explained. Sodium hypochlorite reacts with $CeCl_3$ in alkaline solution as follows: $2Ce^{3+} + OCl^- + 6OH^- + H_2O = 2Ce(OH)_4 + Cl^-$. The ratio of OH^- to OCl^- in (1) is 6 to 1. The reaction of cerous chloride with pure sodium hypochlorite can be described by the following equations: $2Ce^{3+} + OCl^- + 2H^+ = 2Ce^{4+} + Cl^- + H_2O$, $2Ce^{4+} + 8H_2O = 2Ce(OH)_4 + 8H^+$ and $6H^+ + 6OCl^- = 6HOCl$. The over-all equation is: $2Ce^{3+} + 7OCl^- + 7H_2O = 2Ce(OH)_4 + 6HOCl + Cl^-$. In precipitating cerium, 3.5 moles of NaOCl are required per mole of cerium, and 3.0 moles of HOCl are generated. (TTT)

17689 THE PREPARATION AND PHYSICAL PROPERTIES OF YTTRIUM OXYORTHOSILICATE $Y_2O(SiO_4)$. E. K. Keler and A. K. Kuznetsov. Zhur. Priklad. Khim., 35: 250-6(Feb. 1962). (In Russian)

Samples of Y_2O_3 with a grain size of 1 to 3 μ were mixed cristobalite SiO_2 with a grain size of 3 to 6 μ, and fired at temperatures of 1200 to 1600°C. Free Y_2O_3 was selectively dissolved with a saturated, boiling NH_4NO_3 solution. Yttrium silicate was decomposed with boiling HCl (1:5). Free SiO_2 and active SiO_2 were determined by boiling with a 5% Na_2CO_3 solution. It was found that the yield of $Y_2O_3 \cdot SiO_2$ is 8.8% at 1200°C, 22.8% at 1300°C, 41.6% at 1400°C, 55.2% at 1500°C and 93.0% at 1600°C for a 2 hour holding period. The rate of formation of yttrium silicate is limited by the diffusion of Y_2O_3 through a surface layer of the silicate. An addition of 1 wt % Al_2O_3 was most effective in decreasing the porosity and in bringing about almost complete sintering at 1600°C. A study of the electrical properties shows that yttrium silicate is a semiconductor ($\rho = 4.76 \times 10^7$ Ω-cm). On addition of 2 wt % of Al_2O_3, Bi_2O_3, B_2O_3 and ZnO, yttrium silicate becomes a poor dielectric material ($\rho = 1.0 \times 10^{10}$ to 4.78 ×

10^8 Ω-cm). Its resistance to firing is 1930 ± 50°C. The linear expansion coefficient is 4.3×10^{-6} for temperatures of 20 to 1200°C. The thermal stability on thermal cycling is satisfactory. (TTT)

17690 THE SEPARATION OF FLUORINE FROM RARE EARTHS IN SOLUTIONS CONTAINING SIMULTANEOUSLY CALCIUM AND SILICA WITH THE USE OF ION EXCHANGE. D. M. Chizhikov, B. N. Rabinovich, E. A. Subbotina, and V. N. Korsunskaya. Zhur. Priklad. Khim., 35: 276-80(Feb. 1962). (In Russian)

Leaching of a rare earth concentrate with 5% HCl gave solutions with the following composition: 2 to 3 g/l of R_2O_3, 3 to 12.8 g/l of Ca, 0.45 to 1.6 g/l of Fe, 0.4 to 0.8 g/l of F and 0.5 to 0.75 g/l of Si. Preliminary experiments showed that the distribution coefficient for the absorption of rare earths on a sulfonate type of resin (KU-2) decreases from 347 at 0.8 N HCl to 12 at 2 N HCl. At 2 to 3 g/l of rare earths and an acidity of 1.5 N HCl, the capacity is 110 to 120 mgs of rare earths per gram of resin. The slower rate of 1 ml/min-cm^2 was more favorable for the absorption of rare earths than the higher rate of 1 ml/min-cm^2. The rare earths were eluted from the column with 4 N HCl. Analyses showed that a large part of the calcium (75 to 80%) and of the iron (85 to 95%), and also all the silica followed the fluorine on the rare earth absorption step. A single precipitation of the rare earth hydroxides was sufficient to separate out the remainder of the calcium, and since iron had been eliminated, the amount of oxalic acid required to convert the rare earth hydroxides to oxalates was reduced many times. (TTT)

17691 THE PROPERTIES OF $ZrCl_4$ AND $ThCl_4$ SOLUTIONS IN ETHYL ALCOHOL. A. I. Sviridova and N. V. Sulkovskaya. Zhur. Priklad. Khim., 35: 280-5(Feb. 1962). (In Russian)

Alcohol containing less than 0.2 to 0.3% water can dissolve up to 2.0 gr-mols of $ZrCl_4$ and up to 1.5 gr-mols of $ThCl_4$ with the formation of stable clear solutions. The solutions have a strongly acidic reaction and can be titrated with alcoholic KOH. The acidity increases sharply with increasing concentration of salt. An inflection in the acidity versus concentration plot is observed at 0.8 to 0.9 gr-mol/liter. The acidity does not change with time (up to one year). The acidity of a concentrated $ZrCl_4$ solution is higher than the acidity of a concentrated $ThCl_4$ solution of the same molar concentration. The variation in refractive index also shows an inflection at 0.8 to 0.9 gr-mol/liter. It was found that the specific electrical conductivity attains a maximum at 0.8 to 1.0 gr-mol/l. The electrical conductivity is primarily due to the formation of HCl. Metallic sodium or potassium can be used to partially neutralize the $ZrCl_4$ and $ThCl_4$ solutions in order to obtain solutions of different acidity. A solid having the composition $ZrCl_2(OC_2H_5)_2$ was isolated by crystallization from a concentrated solution of $ZrCl_4$ in alcohol. (TTT)

17692 THERMO CHEMISTRY OF COMPLEX FORMATION OF THALLIUM(III). F. Ya. Kul'ba and Yu. A. Makashev (Leningrad Inst. of Tech.). Zhur. Priklad. Khim., 35: 663-4(Mar. 1962). (In Russian)

Thermodynamic values (ΔH, ΔZ, and ΔS) of Tl(III) complexing with 1,10 phenanthroline and 2,2' bipyridyl in aqueous solutions were found at 25°C and ion strength of 1.00. The results are tabulated. (R.V.J.)

17693 SUBLIMATION OF CESIUM OXIDE FROM POLLUCITE CAKED WITH LIME IN VACUUM. A. G. Motina, V. A. Pazukhin, A. I. Lainer, and M. A. Kolenkova (Kalinin Inst. of Non-Ferrous Metals, USSR). Zhur. Priklad. Khim., 35: 664-6(Mar. 1962). (In Russian)

A good separation of cesium oxide was achieved by heating bricks of pollucite with lime in a vacuum at 1200°C for one hour. Additions of 5% CaF_2 improve the process. Sublimation of Cs_2O from alkali sublimate by bromine produces high purity cesium bromine. (R.V.J.)

17694 CHEMICAL PROPERTIES OF MAGNESIUM BORIDES AND ON THEIR PART IN ELEMENTARY BORON PREPARATION BY THERMAL–MAGNESIUM METHOD. L. Ya. Markovskii and G. V. Kaputovskaya. Zhur. Priklad. Khim., 35: 723-9(Apr. 1962). (In Russian)

Studies of chemical reactions of magnesium borides with air, nitrogen, and oxygen at high temperature showed that MgB_{12} has the highest resistance to air oxidation. The data also showed that MgB_6 and MgB_{12} do not react with nitrogen and are inert to hydrogen. (R.V.J.)

17695 IODATE PRECIPITATION OF THORIUM AND TITANIUM SUBGROUP FROM SOLUTIONS CONTAINING SCANDIUM. M. L. Navatanovich and A. S. Chernyak. Zhur. Priklad. Khim., 35: 730-5(Apr. 1962). (In Russian)

Effects of solution temperature, acidity, metal concentration, and precipitant consumption on the selective precipitation of thorium and zirconium iodates from scandium containing solutions were analyzed, and optimum conditions for iodate precipitation were determined. The efficiency of the iodate method of scandium separation from Th and Zr and from Hf and Ti was demonstrated, and production of scandium oxide with less than 0.10% Th and 0.05% Hf, Zr, and Ti was achieved. (R.V.J.)

17696 SORPTION AND DESORPTION OF YTTERBIUM AND EUROPIUM ON GRANULE IONITES IN ELECTRIC FIELD. A. B. Davankov, V. M. Laufer, E. Bortel, and M. M. Teplyakov. Zhur. Priklad. Khim., 35: 769-73 (Apr. 1962). (In Russian)

Extraction and concentration of Eu and Yb from weak solutions by cation resin KU-2 were studied, and conditions for complete desorption (over 95%) in an electric field and for producing concentrated Eu solutions by amalgamation were developed. Desorption in an electric field using a mercury cathode is efficient for Eu separation from Yb and other rare-earth metals. Electrochemical desorption of Eu and Yb with sulfuric acid acting as electrolyte was unsuccessful. (R.V.J.)

17697 INTERMOLECULAR INTERACTION IN THE SYSTEM $(C_4H_9O)_3PO-HNO_3-H_2O$. M. F. Pushlenkov, E. V. Komarov, and M. E. Shurenkova. Zhur. Strukt. Khim., 2: No. 6, 682-9(Nov.-Dec. 1961). (In Russian)

The mutual solubility was determined in the system TBP-HNO_3-H_2O by volumetric titration. The type of solvate formed depends on the concentration of TBP, the nature of the diluent and the ionic strength of the aqueous solution. Infrared spectra in the region of 2.5 to 11 μ show that the 1:1 complex of TBP with HNO_3 can be represented by the formula $(C_4H_9O)_3PO...HONO_2$ rather than by the formula $[(C_4H_9O)_3POH^+][NO_3^-]$. At higher acid concentrations, subsequent molecules of nitric acid add on to the monosolvate according to the following mechanism. TBP... $HO-N\begin{matrix}=O...HONO_2\\ \diagdown O...HONO_2\end{matrix}$...etc. No evidence could be found for the interaction of the oxygen atom in the ether linkage with nitric acid. The existence of dissolved nitric acid in the organic medium could not be confirmed by the infrared absorption data. The dissolved water can form a hydrogen bridge either with the phosphoryl group in TBP or with an oxygen atom in the HNO_3 solvate. It is assumed that water is added to the nitric acid solvate according to the following mechanism: $(C_4H_9O)_3PO...HONO_2...HOH$. (TTT)

17698 NUCLEAR MAGNETIC RESONANCE OF THE SEMI-CRYSTALLINE HYDRATE OF URANIUM TRIOXIDE. N. M. Aleksandrov and L. P. Rodionova (Leningrad State Univ. and Khlopin Radium Inst., Leningrad). Zhur. Strukt. Khim., 3: No. 1, 97-8(Jan.-Feb. 1962). (In Russian)

The position of a hydrogen atom can frequently be determined by the method of nuclear magnetic resonance, especially if the general features of the crystal structure are known from x-ray analysis. The minimum value of the second moment ΔH^2 of a molecule of water is greater than 15 ge^2. A low value for ΔH^2 indicates the absence of crystallization water in the crystal. An anhydrous uranium trioxide was obtained by thermal decomposition of $UO_4 \cdot 2H_2O$ at 350°C in an atmosphere of oxygen. The anhydrous compound was hydrated to $UO_3 \cdot 2H_2O$ by contacting with water at room temperature, and then dehydrated to $UO_3 \cdot (0.83\ H_2O)$ by drying to constant weight at 80°C. The nuclear resonance spectrum was taken, and values of ΔH^2 were found to be 3.42 ge^2 at room temperature and 4.49 ge^2 at 160°K. The nuclear resonance data indicate that the monohydrate of uranium trioxide does not contain hydration water. (TTT)

17699 ADVENTURES IN RADIOISOTOPE RESEARCH. The Collected Papers of George Hevesy in Two Volumes. Volumes One and Two. New York, Pergamon Press, 1962. 1051p. $30.00.

The 100 papers contain information on research in the fields of inorganic and physical chemistry and medical sciences. Topics investigated in chemistry include analytical applications, activation analysis, electrochemistry, interchange studies, self diffusion, and tracer studies. Work reported in medical sciences include skeleton studies, phosphatides, fatty acids, acid soluble phosphorus compounds, permeability studies, application of radioactive tracers occurring in nature, labeling red corpuscles, clinical investigations, iron metabolism, nucleic acids, studies in radiobiology, botanical studies, and radioisotope studies. (N.W.R.)

17700 REMOVAL OF RUTHENIUM AND CESIUM. Woodland E. Erlebach and Danny T. Nishimura (to Atomic Energy of Canada Ltd.). U. S. Patent 3,018,161. Jan. 23, 1962.

A method is given for removing radioactive Ru and Cs from gases. The method comprises flowing the gases in contact with a metal oxide and a refractory silicate which react with Ru and Cs, respectively, to form thermally stable compounds. The metal oxide is one of the oxides of Fe, Ni, Cr, Co, and Ti. The reaction is carried out in a reactor at 400 to 1000°C with the reagents as packing. (D.L.C.)

17701 STABLE AQUASOLS OF HYDROUS RARE EARTH AND THEIR PREPARATION. William H. Pasfield (to E. I. du Pont de Nemours & Co.). U. S. Patent 3,024,199. Mar. 6, 1962.

A process is given for preparing concentrated stable hydrous rare earth oxide aquasols of 10 to 50 wt % of rare earth oxide particles of 5 to 200 mμ in the largest dimension and with a length/diameter ratio of 1:1 to 5:1. The process comprises contacting an aqueous solution of a rare earth salt containing monovalent anions with NH_3 to precipitate hydrous rare earth oxide, removing the major portion of the NH_4^+ salts while maintaining the pH at 9.5 to 10.5, and peptizing the hydrous rare earth oxide by heating at 60 to 100°C for 5 to 60 min while agitating. This aquasol can be concentrated by evaporation. Examples of the process are given in which aquasols of didymium, cerium, and lanthanum oxides were prepared. (D.L.C.)

17702 PROCESS FOR REMOVAL OF RADIOACTIVE CONTAMINANTS. Frank G. Morris (to Purex Corp., Ltd.). U. S. Patent 3,033,794. May 8, 1962.

An improved composition is given for decontaminating surfaces, especially clothing of personnel handling radioactive materials. The composition comprises 20 to 80% polyphosphate, 1 to 25% nonionic detergent, and 5 to 50% monohydroxy aliphatic monocarboxylic acid, preferably hydroxy acetic acid. To prepare a solution for decontamination use, 2 to 5 ounces of the anhydrous composition is added per gallon of water. Results of decontamination tests run on uranium, plutonium, and soft beta emitters are given. (D.L.C.)

17703 COMPOSITIONS AND PROCESS FOR REMOVAL OF RADIOACTIVE CONTAMINANTS. Elmer L. Brevik (to Purex Corp. Ltd.). U. S. Patent 3,033,795. May 8, 1962.

An improved composition for decontaminating surfaces of metals, concrete, porcelain, etc., is described which is relatively non-toxic. The composition comprises an aqueous acid solution containing sulfamate, fluoride, and chloride ions, and its pH should be less than 1.5. A surface-active agent may be added to improve the efficiency of the solution. During the decontaminating action, the radioisotopes are complexed and removed from the surface; the complexes, being relatively unstable, may then be precipitated from the solution by heat. (D.L.C.)

17704 PURIFICATION OF SODIUM DIURANATE. Robert E. Reusser (to Phillips Petroleum Co.). U. S. Patent 3,034,856. May 15, 1962.

A method is outlined for purifying yellow cake comprising sodium diuranate obtained by extracting uranium values from uranium ores with the carbonate leaching process. The method comprises contacting the sodium diuranate with aqueous sulfamic acid to dissolve the uranium values therein, leaving vanadium and other impurities as a residue, and recovering uranium values from the filtered solution by precipitation as the diuranate with sodium hydroxide. The preferred conditions for carrying out the method are: weight ratio of sulfamic acid to orginal yellow cake, 0.7 to 1.6; concentration of aqueous sulfamic acid, 0.5 to 25 wt % acid; and contact time 0.5 to 3 hr at 20 to 100°C. (D.L.C.)

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Refer also to abstract 17583.

17705 (GCM/UK/25) RADIATION INDUCED REACTIONS IN THE SYSTEM, CARBON DIOXIDE, CARBON MONOXIDE, GRAPHITE. T. B. Copestake and N. S. Corney (General Electric Co., Ltd. Central Research Labs., Wembley, England). [nd]. 39p.

Presented at the Libby-Cockcroft Meeting on Gas Coolant Compatibility, Harwell, Berks, England, April 1962.

A discrepancy reported in the recent summary report was traced to the presence of mercury in the bulbs irradiated in the early stages of the work. This mercury causes a reduction in the yields of carbon monoxide by a factor of about two for bulbs with axial graphite specimens. Consistent behavior was obtained in a number of experiments where mercury was systematically added. Different but self-consistent results were obtained by reduction of mercury to a low level. Anomalous results were obtained at low carbon dioxide filling pressures. Possible causes are suggested and work is in progress to examine this pressure

region more carefully. Irradiation of carbon dioxide and graphite to high doses produces visible black or brown deposits. The carbon monoxide content obtained in these irradiations appears to reach a limit which is not exceeded on further irradiation. This limit is dependent upon the initial carbon dioxide filling pressure and the geometrical arrangement of graphite specimen in the bulb. The irradiation of carbon monoxide–carbon dioxide mixtures in the presence of similar graphite specimens brings about changes such that the composition of the gas mixtures tends towards this limit. The irradiation of carbon monoxide alone and in the presence of graphite was studied. The stoichiometry appears to correspond to 3 CO → CO_2 + solids. (auth)

17706 (GCM/UK/42) USE OF ^{14}C TRACERS IN THE STUDY OF THE RADIATION INDUCED REACTIONS IN THE SYSTEM GRAPHITE, CARBON DIOXIDE, CARBON MONOXIDE. H. J. Cluley and N. S. Corney (General Electric Co., Ltd. Central Research Labs., Wembley, England). [1962]. 15p.

Presented at Libby-Cockcroft Meeting on Gas Coolant Compatibility, Harwell, Berks, England, April 1962.

Preliminary studies are reported of the system graphite–carbon dioxide–carbon monoxide under irradiation, using C^{14}-labeled gases; particular attention was paid to the deposition reaction. Results are presented for analyses on a series of silica bulbs containing graphite specimens in rod form and filled with C^{14}-labeled CO_2, which had been irradiated in a gamma flux. The amounts of CO formed were small (<1%) and examination of the graphite specimens for C^{14} showed that the deposition reaction had occurred to a barely detectable extent. Results are also presented for analyses on a similar series of bulbs which had been irradiated in a neutron flux (in DIDO). Much larger amounts of CO (up to 30%) were obtained in this series. The results of isotopic analysis of the gas after irradiation were consistent with the over-all reaction $C + CO_2 \rightarrow 2CO$ and with a value for the equilibrium constant of the $CO - C^{14}O_2$ exchange reaction close to that reported elsewhere. Readily detectable amounts of deposited C^{14} activity in the graphite and on the bulb were found in each irradiation, and although the amounts found were not a wholly consistent function of CO activity and of dose, there is some evidence of increasing efficiency of deposition with increasing filling pressure. (auth)

17707 (NAA-SR-6669) SECTION V. ORGANIC RADIATION CHEMISTRY. J. G. Burr (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1962. Contract AT(11-1)-Gen-8. 33p.

A review of current and important trends in the field of organic radiation chemistry is presented. (60 references) (auth)

17708 (TID-14812) LOW ENERGY INVESTIGATIONS OF RADIATION CHEMISTRY. Technical Progress Report. Robert W. Kiser (Kansas State Univ., Manhattan). Jan. 22, 1962. Contract AT(11-1)-751. 244p.

Preliminary studies of the shapes of ionization efficiency curves of multiply-charged Kr and Xe ions were made and used to derive ionization potentials and electronic transition probabilities. The color and free radicals formed in the decomposition of some condensed organic solids by charged particle bombardment were studied. Electron impact studies were made on cyano-compounds, substituted ethylene oxides, multi-ring heterocyclics, trifluoroethanol, propylene sulfide, isocyanates, isothiocyanates, organometallic compounds, and sulfur compounds. The C^{14}-labeled chemical species produced in the pile neutron irradiation of acetamide and cyanoguanidine were studied. A study was made of the properties of octahedral coordination compounds of nickel(II) and cobalt(II) with ethylenimine. The performance of propane–argon and propane–helium mixtures as Geiger-Müller counter gases was studied. (D.L.C.)

17709 SYNTHESIS OF ALPHA- AND BETA CARBON ISOTOPICALLY LABELLED FURAN. Boerge Bak, Joergen Tormod Nielsen, and Marianne Schottlaender (Universitet, Copenhagen). Acta Chem. Scand., 16: 123-6 (1962). (In English)

The preparation of 200 mg quantities of 22% enriched [α-C^{13}] furan and [β-C^{13}] furan from enriched $KC^{13}N$ is described. The over-all yields are, respectively, 11 and 8% with respect to $KC^{13}N$. The first synthesis involves 6 steps, the second 17 steps. The purity, as controlled by the infrared gas-spectrum, was highly satisfactory. (auth)

17710 IDENTIFICATION OF THE CHEMICAL FORM OF RADIOACTIVE IONS AT SUBMICROMOLAR CONCENTRATIONS. R. W. Henkens and D. R. Kalkwarf (General Electric Co., Richland, Wash.). Anal. Chem., 34: 830-5 (June 1962). (HW-SA-2356)

Paper electrophoresis was used to separate and identify the chemical forms of radioactive ions at concentrations of less than 10^{-12}M. Identifications were made by comparing the free-solution mobilities of these ions with those calculated from the limiting ionic conductances of known forms. The identifications were confirmed by comparison of the electrophoretic migration of known and unknown ions under identical conditions. (auth)

17711 DETERMINATION OF O^{18} CONCENTRATION OF SUGARS AND GLYCOGEN. J. S. Lee (Univ. of Minnesota, Minneapolis). Anal. Chem., 34: 835-7 (June 1962).

A method for the determination of O^{18} content of sugars and glycogen is described. It involves the oxidation of these compounds to yield CO_2 in the presence of $Hg(CN)_2$ and mass spectrographic analysis of CO_2. The HCN gas probably formed in the oxidation process was removed simply by a dry ice–acetone trap. (auth)

17712 A MEASUREMENT CELL WITH AUTOMATIC CLEARANCE DEVICE FOR MEASURING RADIOACTIVE ION-EXCHANGE ELUATES. G. Dinstl (Universität, Vienna). Atompraxis, 8: 151-2(Apr. 1962). (In German)

An arrangement is given for continuous measurement of radioactive ion-exchange eluates in which the solution flows directly from the exchange column into a cylindrical cavity in a polyethylene block. Because of the slight thickness of the polyethylene sealer foil, low-energy β radiation can also be measured. (auth)

17713 OBSERVATIONS ON THE MICROCALORIMETRIC CALIBRATION OF A RADIUM SOURCE. S. Faggiani (Università, Rome). Energia nucleare (Milan), 9: 168-70 (Mar. 1962). (In English)

A brief account is given of the calorimetric methods for determining the activity of radioactive sources, with particular reference to radium. A discussion follows concerning the possibility and convenience of determining these values directly, and results are given of certain measurements with a Ra specimen. (auth)

17714 CROSS LINKING OF TEFLON 100 FEP-FLUOROCARBON RESIN BY RADIATION. G. H. Bowers and E. R. Lovejoy (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Ind. Eng. Chem., Prod. Research and Develop., 1: 89-92 (June 1962).

Teflon 100 FEP-fluorocarbon resin, a copolymer of tetrafluoroethylene and hexafluoropropylene, cross-links when exposed at elevated temperatures to radiation. High energy electrons, x-rays, and ultraviolet light were used to induce cross linking in FEP resin; the key is irradiation at temperatures above the glass I transition (internal friction) temperature where cross linking predominates over degradation. By proper selection of radiation dose and temperature, modified resins with wide ranges of properties can be made. Discussion is given on the effect of radiation dose at elevated temperatures on tensile, aging, toughness, and electrical properties. Large doses of radiation cross-link the polymer in the form of wire insulation to the point where its resistance to high temperature cut-through is greatly improved. Small amounts of radiation alter melt flow characteristics by changing the molecular weight and molecular weight distribution. The effects of this change on the dependence of the shear rate on shear stress are also discussed. (auth)

17715 LARGE SECONDARY INTERMOLECULAR KINETIC ISOTOPE EFFECTS IN NON-EQUILIBRIUM SYSTEMS. ENERGIZATION BY PHOTOSENSITIZATION. B. S. Rabinovitch (National Research Council, Ottawa) and D. W. Setser. J. Am. Chem. Soc., 84: 1765-6(May 5, 1962).

The occurrence of very large normal secondary intermolecular kinetic isotope effects in non-thermally activated unimolecular systems for an energization technique other than chemical activation is pointed out. Photosensitization $Hg(^3P_1)$ experiments were performed on ethylene molecules. The relative split off rates from sym-$C_2H_2D_2$, given as $H_2:HD:D_2$, were found to be 2:6:1.05. An equation for the secondary effect is given. It is known that split off occurs readily by $Hg(^3P_1)$ sensitization (112 kcal/mole). Thus for mercury photosensitization ϵ^+ may have some value up to 19 kcal/mole, and is probably not close to zero. It is felt that the magnitudes found are quite reasonable. (P.C.H.)

17716 RADIATION CHEMISTRY OF IONIC SOLIDS. II. FREE RADICALS DETECTED IN IRRADIATED POTASSIUM NITRATE BY ELECTRON PARAMAGNETIC RESONANCE. Joseph Cunningham (Argonne National Lab., Ill.). J. Phys. Chem., 66: 779-87(May 1962).

Crystals of $K^{14}NO_3$ and $K^{15}NO_3$ were irradiated and studied at 4 and 77°K. Six distinct species were indicated by the electron paramagnetic resonance (epr) spectra. Tentative identification of individual epr patterns with radical species in fixed orientations is attempted. The magnetic parameters of patterns assigned to $(NO_2^-)^-$, NO_2, $(NO_3^-)^-$, NO_3, NO, and O_2^- radicals are shown to be not inconsistent with previous results and with orbital representation. Results are described on optical removal of the epr signals. The relationship of radical formation and orientation to the radiation chemistry of nitrates is considered. (auth)

17717 ELECTRON SPIN RESONANCE INVESTIGATION OF NEUTRON IRRADIATED POLYPROPYLENE. Ramdas P. Gupta (Institute for Elektrowerkstoffe, Freiburg i. B.). J. Phys. Chem., 66: 849-52(May 1962).

Investigation on neutron irradiated isotactic polypropylene was done by electron spin resonance experiments to study the effect of the ionizing radiation on radical formation, cross linking, and formation of the chemical bond. The samples of polypropylene were pile irradiated at neutron dosages of 5.4×10^{17}, 6.8×10^{17}, 5.7×10^{18}, and 14.0×10^{18} nvt. As the irradiation dose increases, the line becomes more sharp. There is a marked decrease in half-width with increase in irradiation dose. There was evidence of the presence of some methyl groups in the irradiated specimen, though some of the methyl groups are destroyed by irradiation. It is more likely that color formation could be due to a conjugated double bond structure than to a long life radical. Narrowing of the line width, in this case, is not due to exchange interaction of the unpaired electrons but is due to an increase in the conjugated region of the double bond structure with the stable radical formed by neutron irradiation. The increase in the conjugated region lowers the neighbor interaction, on account of which there is a narrowing of the line width with increase in dose at high neutron dosages. (auth)

17718 RADIATION INDUCED EXCHANGE OF PHOSPHORUS IN THE PCl_3-POCl_3 SYSTEM. LeRoy F. Grantham and Herbert C. Moser (Kansas State Univ., Manhattan). J. Phys. Chem., 66: 863-6(May 1962).

Phosphorus-32 was used as a tracer to measure the rate of radiation induced exchange of phosphorus in PCl_3-POCl_3 binary solutions. Ultraviolet and γ radiation induced sufficient exchange to permit a study of the kinetics of the system, but exchange was not induced by visible light. The amount of phosphorus exchanged was found to obey the equation $M = k'bD + k''abD$, where a and b are concentrations of PCl_3 and $POCl_3$, respectively, and D is the gamma or ultraviolet dosage. Values for $k\gamma'$ and $k\gamma''$ were found to be $(3.19 \pm 0.16) \times 10^{-18}$ rad^{-1} and $(4.24 \pm 0.31) \times 10^{-11}$ g $mmole^{-1}$ rad^{-1}. For γ rays the ratio k'/k'' was 15 times larger than it was for ultraviolet radiation. (auth)

17719 FORMATION OF HYDROGEN ATOMS IN IRRADIATED CATALYSTS. P. H. Emmett, R. Livingston, H. Zeldes, and R. J. Kokes (Johns Hopkins Univ., Baltimore and Oak Ridge National Lab., Tenn.). J. Phys. Chem., 66: 921-3(May 1962).

Irradiation of silica gel, alumina, and silica–alumina catalysts at −195° with a Co^{60} γ source produces hydrogen atoms detectable by the use of an electron spin resonance spectrometer on the cold (−195°) sample. About 1×10^{17} hydrogen atoms per gram were produced in silica gel and in alumina; about 12×10^{17} per gram of sample were produced in the silica–alumina catalyst and also in a sample of catalyst that had been base exchanged with Ba^{2+} ions. A silica–alumina catalyst originally equilibrated with 70% relative humidity at 25° showed hydrogen atom yields increasing with an increase of temperature of sample evacuation up to about 250° and then decreasing as the temperature of evacuation was increased to 500°. (auth)

17720 THE EFFECT OF IRRADIATION UPON THE KINETICS OF AN ENDOTHERMIC SOLID REACTION. THE DEHYDRATION OF MANGANOUS OXALATE DIHYDRATE. Ted B. Flanagan and Chang Hwan Kim (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 926-30(May 1962). (BNL-5655)

The kinetics of dehydration of virgin and reactor irradiated manganous oxalate dihydrate were examined with the aid of a quartz helix balance. The maximum rate of dehydration was noted to increase by a factor of approximately 3 times (70°) while the activation energy was reduced from 22.3 ± 0.7 to 17.3 ± 0.7 kcal/mole after a total neutron dose of 6.05×10^{18} n cm^{-2}. (auth)

17721 A CONSIDERATION ON THE CHANGE OF ESR SPECTRAL SHAPE OF IRRADIATED POLYETHYLENE NEAR 240°K. Hisatsuga Kashiwabara (Japanese Assn. for Radiation Research on Polymers, Tokyo and Fuji Spinning Co., Tokyo). J. Phys. Soc. Japan, 17: 567-8(Mar. 1962). (In English)

Changes in shape in the characteristic electron spin

resonance spectra of allylic-free radicals in irradiated polyethylene near 240°K are considered. These result from steric configuration variations due to changes of the situations of the hyperfine interaction. Data are presented in graphical form. (L.N.N.)

17722 ELECTRON SPIN RESONANCE OF IRRADIATED POLYOXYMETHYLENE. Hiroshi Sasakura, Nozomu Takeuchi, and Toshiaki Mizuno (Indistrial Research Inst., Osaka). J. Phys. Soc. Japan, 17: 572(Mar. 1962). (In English)

The types of radicals formed in irradiated polyoxymethylene are suggested from electron-spin-resonance spectral measurements. (L.N.N.)

17723 EFFECT OF FREE RADICALS ON THE PROTON RESONANCE OF IRRADIATED POLYMERS. Atsushi Komaki, Syukuro Yano, Hiroshi Yoshida, and Seizo Okamura (Kyoto Univ.). J. Phys. Soc. Japan, 17: 581(Mar. 1962). (In English)

Effects of trapped radicals on the proton magnetic resonance in irradiated polymers were studied by examining changes in the resonance line shape and in the spin-lattice relaxation time (T_1) in polyethylene. Measurements were performed at 16 Mc, and T_1 was determined by saturation. Materials were irradiated by Co^{60} γ in a vacuum at room temperature. Line shape and concentration of free radicals trapped in the materials were determined by electron paramagnetic spin resonance. (L.N.N.)

17724 EFFECT OF VULCANIZATION STRUCTURES ON THE STRENGTH OF VULCANIZATES. B. A. Dogadkin, Z. N. Tarasova, I. I. Gol'berg, and K. G. Kuanyshev (Moscow Inst. of Fine Chemical Tech.). Kolloid. Zhur., 24: 141-51(Mar.-Apr. 1962). (In Russian)

An equation is presented which shows that the maximum tensile strength at the vulcanization optimum is achieved at a definite ratio between the number of strong (C–C type) bonds and weak (molecular and salt type) bonds. Weak vulcanization bonds facilitate stress dissipation, the specimen being held intact by the strong bonds. It was experimentally shown that the strength of carboxylate rubber vulcanizates is augmented by additional formation of carbon-carbon bonds under the influence of γ radiation. Similarly the strength of sulfur vulcanizates containing polysulfide bonds increases under the action of low doses of γ rays. The dynamic strength depends upon the type of bonds and upon the conditions under which the repeated deformations are carried out. Under conditions of symmetrical alternating-sign twist with bending and of linear deformation at constant maximum stress and amplitude of deformation the dynamic (fatigue) strength increases in energy of the cross-linkages. A linear dependence between the rate constants of creep and the number of deformations before the onset of rupture is observed for the various vulcanizates under the above conditions. (auth)

17725 EFFECT OF THE RIPENING TIME OF FERRIC HYDROXIDE GEL ON THE ADSORPTION OF RADIOACTIVE ISOTOPES. V. V. Pushkarev and V. F. Bagretsov (Kirov Urals Polytechnic Inst., Sverdlovsk, USSR). Kolloid. Zhur., 24: 238-40(Mar.-Apr. 1962). (In Russian)

The degree of adsorption of Sr^{90} at about pH 8.0 falls noticeably only in the first three days of aging of ferric hydroxide gel provided it is kept in solution. Practically no change in adsorption of Ce^{144} and Ru^{106} at about pH 6.3 takes place with respect to the ripening time of the gel. (auth)

17726 RADIATION INDUCED BLOCK AND GRAFT COPOLYMERIZATION OF DISPERSION OF POLYMETHACRYLATES WITH ACRYLONITRILE. Christel Schneider, Jakob Herz, and Dieter Hummel (Universität, Cologne). Makromol. Chem., 51: 182-98(1962). (In German)

Graft and block copolymers were prepared by grafting acrylonitrile onto preirradiated aqueous dispersions of polymethylmethacrylate. The influence of different experimental conditions as irradiation time, dose rate, and the time between irradiation and addition to the monomer on the course of the reaction was studied in detail. Fractional precipitation of the copolymer showed no homopolymer acrylonitrile, but only a fractionation according to a decreasing content of polyacrylonitrile. Determination of the molecular weight by measuring the intrinsic viscosity in dimethylformamide led to an average molecular weight of 300,000 to 325,000. Analogous grafting on other polymethacrylates was successful only in the case of polyethylmethacrylate. From this, a conclusion was drawn as to the structure of the initiating radicals in the preirradiated dispersions. The kinetics of the radical formation are given by $dR/dt = k \cdot I - k' (R)^2$ corresponding to those of the radical formation in solid polymethylmethacrylate. (auth)

17727 SPECIFIC ELEMENTARY PROCESSES IN THE RADIATION CHEMISTRY OF ORGANIC OXYGEN COMPOUNDS. T. Ffrancon Williams (Univ. of Tennessee, Knoxville). Nature, 194: 348-51(Apr. 28, 1962).

A mechanism is proposed to explain the effects of high-energy radiation on oxygen-containing organic compounds. The mechanism is based on two premises: that reactions of the parent molecule-ion involving low-activation energies precede the neutralization of the radiation-produced ion; and that the reactions of the parent molecule-ion are strongly directed by the tendency of the O atom to complete its valence electron shell. (T.F.H.)

17728 'HOT'-ATOM CHEMISTRY OF RADIOCOBALT IN HEXAMMINECOBALT(III) HEXACYANOCOBALTATE(III) AND HEXAMMINECOBALT(III) HEXACYANOFERRATE(III). Nobufusa Saito, Takeshi Tominaga, and Hirotoshi Sano (Tokyo Univ.). Nature, 194: 466-7(May 5, 1962).

Solid complex salts $[Co(NH_3)_6][Co(CN)_6]$ and $[Co(NH_3)_6][Fe(CN)_6]$ were studied in order to elucidate the role of CN groups in recoil reactions. Following irradiation and varied storage time, the salts were dissolved in 0.3 M HCl and species labeled with Co^{60} were separated by procedures involving ion exchange, paper electrophoresis, recrystallization, or a combination. Major components labeled with Co^{60} in the solution of the irradiated salt were CoA_5^{2+}, Co^{2+}, and CoX_6^{3-} (A = mostly NH_3, X = mostly CN). On the storage of the irradiated salts at room temperature, CoA_5^{2+} was increased, Co^{2+} was decreased, and CoX_6^{3-} remained almost unchanged. Also, appreciable amounts of Co^{60}-labeled cyanocobaltate ions were found in the solution of irradiated $[Co(NH_3)_6][Fe(CN)_6]$. Distribution of the Co^{60}-labeled species in both salts was essentially the same. $[Co(NH_3)_6][Co(CN)_6]$ contains cobalt atoms in both cationic and anionic components, whereas $[Co(NH_3)_6][Fe(CN)_6]$ contains cobalt only in cationic component. (P.C.H.)

17729 DISTRIBUTION PATTERNS OF ISOTOPIC PEAKS IN THE MASS SPECTRUM OF STANNIC BROMIDE. Francis J. Norton (General Electric Research Lab., Schenectady, N. Y.). Nature, 194: 467-8(May 5, 1962).

Calculation of the isotopic peak distributions for stannic bromide ions is discussed. If the fractional Br^{79} and Br^{81} abundances are taken as a and b, the ion group peak heights for a single tin isotope of abundance S is given by the dis-

tribution equation $S(a + b)^n$, where n takes the values 4-1 for the various bromine containing ions. This is calculated and weighted for each tin isotope and the totals summed for each mass in the group. The calculated and experimental distributions are given. The possibility of using stannic iodide is also discussed. (P.C.H.)

17730 RESEARCH OF RADIOISOTOPE PRODUCTION WITH FAST NEUTRONS. II. PREPARATION OF ^{24}Na OF HIGH SPECIFIC ACTIVITY. Chizuko Shikata, Eiji Shikata, and Nagao Shibata (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 149-53(Mar. 1962). (In English)

Na^{24} of high specific activity was produced in JRR-1 reactor by the reaction $Mg^{24}(n,p)Na^{24}$. The cation exchange method was applied to separate Na^{24} from neutron irradiated magnesium oxide. Na^{24} of up to 300 times as high specific activity as that produced by the reaction $Na^{23}(n,\gamma)Na^{24}$ was prepared. The reaction $Al^{27}(n,\alpha)Na^{24}$, which produces Na^{24} in carrier-free, was also investigated. There was no difference on the production yield of Na^{24} between the (n,p) and (n,α) reaction, but the former was preferential in regard to the chemical treatment. (auth)

17731 DESIGN OF RADIATION CHEMICAL REACTORS WITH SPECIAL REFERENCE TO THE POLYMERIZATION OF ETHYLENE. Melvin M. Levine and Meyer Steinberg (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 498-504(Apr. 1962).

A general solution for optimum design of a radiation chemical reaction vessel having an internal uniform triangular array of long, thin γ-ray sources is derived. The dependence of chemical production rate on amount and distribution of radioactive material and on size and shape of vessel is accounted for. Values for two general design parameters (vessel efficiency, Ψ, and unit cell efficiency, μ) as a function of the vessel diameter and source spacing are given and include radiation buildup. The rate equation expressed as a power law of the radiation intensity is combined with information on the dependence of cost of reactor vessel on volume and pressure. The total cost of source material and vessels is then minimized to determine optimum size and number of vessels and the number of curies of radiation. The rate and cost equations are applied to the radiation polymerization of ethylene. By the methods outlined it is possible to determine the parameters of an optimum irradiation assembly. The dimensions of the vessel and source array and the quantity of radioactive source material necessary for a given rate of production are determined for the minimum cost condition. (auth)

17732 SPECIFIC ACTIVITY AFTER INTERMITTENT IRRADIATION. Juan Flegenheimer (Comisión Nacional de Energia Atómica, Buenos Aires) and Yizhak Marcus. Nucleonics, 20: No. 5, 75-6(May 1962).

To simplify calculation of the final specific activity obtained when samples are activated by intermittent irradiation in a research reactor, a graphical method that uses normalized growth and decay curves is shown and given. If flux is constant for all irradiation periods, the theory allows a direct graphical solution; but when irradiations are made at several flux levels, one must find from the graph a component of the total activity for each irradiation and then sum the components to get the total normalized specific activity. (N.W.R.)

17733 RADIOCHEMISTRY CAN HELP ANALYZE NUCLEAR ACCIDENTS. William S. Lyon, Sam A. Reynolds, and James S. Eldridge (Oak Ridge National Lab., Tenn.). Nucleonics, 20: No. 5, 92-5(May 1962).

Various radiochemical methods are discussed for detecting and measuring contamination released from nuclear accidents. The methods can identify radioisotopes in the contamination spread to nearby areas and can estimate fluxes at various locations in the accident area. The data obtained help in evaluating the severity of the reaction and often can show how to prevent similar accidents. A list of fission products useful in determining number of fissions in reactor incidents is presented along with lists of important alpha emitters and long-lived fission products. (N.W.R.)

17734 INEXPENSIVE DISPOSABLE FURNACE FOR RADIOCHEMISTRY. Richard C. Doyle and Will D. Phillips (Univ. of California, Berkeley). Nucleonics, 20: No. 5, 98 (May 1962).

The design and construction of a small, inexpensive, disposable electric resistance furnace for studying the chemistry of radioisotopes are described. The vertical cylinder-type unit will accommodate 50-ml centrifuge cones and 0 and 00 crucibles. Other features of the simple sheet-metal-can furnace are: small enough to pass through a glovebox door, open at the top, has external heat control (variable transformer), resistant to corrosion from acid vapors (epoxy and phenolic resin coated), and easy to fabricate. (N.W.R.)

17735 INVESTIGATION OF THE SPECTROPHOTOMETRIC METHOD OF MEASURING THE FERRIC ION YIELD IN THE FERROUS SULFATE DOSIMETER. Karl Scharf and Richard M. Lee (National Bureau of Standards, Washington, D. C.). Radiation Research, 16: 115-24(Feb. 1962).

The sensitivity of the spectrophotometric method of measuring the ferric ion yield in the ferrous sulfate dosimeter was increased by measuring the absorbance of the radiation produced ferric ions at 224 mμ, instead of at 304 mμ. The higher sensitivity is due to the higher molar extinction coefficient at 224 mμ which is 4565 liter $mole^{-1}$ cm^{-1}, compared with 2196 liter $mole^{-1}$ cm^{-1} at 304 mμ. By this method, the measuring range of the ferrous sulfate dosimeter can be extended to smaller doses. The much smaller temperature dependence and smaller acidity dependence of the molar extinction coefficient at 224 mμ, compared with those observed at 304 mμ, increase the reproducibility of dose measurements. (auth)

17736 POLYMERIZATION OF GLUCOSE INDUCED BY GAMMA RADIATION. S. A. Barker, I. R. L. Lloyd, and M. Stacey (Univ. of Birmingham, Eng.). Radiation Research, 16: 224-31(Mar. 1962).

The dependency of the polymer yield on dose rate and total dose during the irradiation of glucose was investigated; the yield of polymer was found to fall off logarithmically with increased dose rate. Different types of polymer which have suffered varying amounts of radiation damage are produced under differing conditions. The effects of barium carbonate, carbon monoxide, and hydrogen on polymer yield and structure were also investigated. Polymers from certain related compounds were isolated. (auth)

17737 EVIDENCE FOR "THERMAL SPIKES" IN THE ALPHA-PARTICLE RADIOLYSIS OF NITRATE CRYSTALS. C. J. Hochanadel (Oak Ridge National Lab., Tenn.). Radiation Research, 16: 286-302(Mar. 1962).

Yields were determined for the decomposition of several alkali nitrate crystals by Po^{210} α particles. These were compared with yields for decomposition by γ and x rays and ultraviolet light at several temperatures. There is a pronounced effect of LET, and the effect of increasing LET

(γ rays to α particles) roughly parallels that produced by increased temperature in the decomposition by radiations of low LET. It is suggested that, in addition to the high concentration of intermediates, the high temperature in heavy-particle tracks (thermal spikes) may also be an important factor in determining the track effect (LET effect). (auth)

17738 SOME EFFECTS OF IONIZING RADIATION ON METHIONINE SULFONIUM COMPOUNDS. F. Schlenk and J. L. Dainko (Argonne National Lab., Ill.). Radiation Research, 16: 327-35(Mar. 1962).

S-Adenosylmethionine and S-methylmethionine show no unusual sensitivity toward x and γ irradiation. They resemble methionine and adenosine in this respect. S-Adenosylmethionine, located after biosynthesis in the vacuoles of yeast cells, is not released by 400 kr of x irradiation. The enzymatic synthesis of the sulfonium compound, including formation of the purine and ribose structure from simple precursors, was virtually unimpeded after exposure of the yeast cells to 400 kr of x irradiation or to 1.0 Mrad of γ irradiation. (auth)

17739 EFFECT OF TEMPERATURE ON THE DECOMPOSITION OF WATER BY GAMMA RAYS. C. J. Hochanadel and J. A. Ghormley (Oak Ridge National Lab., Tenn.). Radiation Research, 16: 653-60(May 1962).

Yields for several γ-ray-induced reactions in 0.4 M sulfuric acid solution show small temperature coefficients, some of which are positive and some negative. This can be interpreted as an effect of temperature on yields of intermediates, with increased temperature giving higher radical yields and lower molecular yields. In the diffusion model this is consistent with a broader initial distribution of primary species at higher temperature. (auth)

17740 SOME REACTIONS OF DEUTERIUM ATOMS IN THE RADIOLYSIS OF AMINO ACIDS, PEPTIDES, THIOLS, AND ALCOHOLS IN HEAVY WATER. Peter Riez and Bernard E. Burr (National Cancer Inst., Bethesda, Md.). Radiation Research, 16: 661-7(May 1962).

Deuterium atoms, produced by irradiating oxygen-free D_2O solutions with 230-kvp x rays, react with organic solutes by abstracting hydrogen (or deuterium) from carbon, oxygen, and sulfur and by other processes. In order to determine the site or sites of abstraction, solutes were deuterium-labeled on nitrogen, oxygen, or sulfur, leaving hydrogen bound to carbon. For acetamide, glycine, and glycylglycine in neutral solutions, $G(D_2) = 0.40 \pm 0.02$. Since this is smaller than the primary molecular D_2 yield, $g_{D_2} = 0.49 \pm 0.02$, it follows that D atoms do not abstract from nitrogen in the $-COND_2$, $-COND-$ and $-N^+D_3$ groups. The D_2 yields from solutions of cysteine and n-butylthiol are 0.86 and 0.83, respectively, and hence abstraction from the –SD group occurs. For cysteine in neutral solution more than 90% of the abstraction reaction takes place at the –SD group. For methanol, ethanol, isopropanol, and formic and acetic acids in acid solutions, the D_2 yields are equal to or smaller than the primary molecular D_2 yield, and therefore abstraction takes place very predominantly at carbon. The yield of D atoms which react by abstraction in neutral solutions is 0.6 ± 0.1 for acetamide, glycine, glycylglycine, n-butylthiol, cysteine, and serine. Hence it appears likely that 75% of the D atoms (or their precursors) react with these solutes by processes other than H or D abstraction. (auth)

17741 THE EFFECT OF pH ON THE HD AND H_2 YIELDS IN THE RADIOLYSIS OF AQUEOUS METHYL-d_3 ALCOHOL. EVIDENCE FOR H ATOM PRECURSORS. Peter Riesz and Bernard E. Burr (National Cancer Inst., Bethesda, Md.). Radiation Research, 16: 668-73(May 1962).

H_2 and HD yields from Co^{60} γ-irradiated solutions of 0.1 M methyl-d_3 alcohol in deaerated water were measured over the pH range 0.4 to 9. In sulfuric acid solutions (pH 0.4 and 1.8) the initial yields from experiments in the dose range 1 to 10×10^{20} ev/l are $G(HD) = 3.3 \pm 0.1$ and $G(H_2) = 0.90 \pm 0.03$. Since the primary molecular hydrogen yield (g_{H_2}) is 0.42, abstraction from oxygen as well as from carbon of methyl-d_3 alcohol occurs. A correction was calculated for H_2 originating from a small amount (2%) of methyl-d_2 alcohol present in methyl-d_3 alcohol. With increasing pH, both G(HD) and $G(H_2)$ decrease; however, the ratio of the rate of abstraction from oxygen to the rate of abstraction from carbon, $k_o/k_c = [G(H_2) - g_{H_2}]/G(HD)$, is constant and equal to 0.15 ± 0.01 in the pH range 0.40 to 5.0. Above pH 5 the ratio k_o/k_c increases with increasing pH from a value of 0.30 ± 0.02 for neutral water to 0.7 at pH 9.3. Only those mechanisms in which it is assumed that the reducing radicals produced in the radiolysis of water can exist in two different forms are consistent with the observed pH effects. (auth)

17742 THE CHANGE IN RADIATION SENSITIVITY OF CHOLINE CHLORIDE AT THE PHASE TRANSITION. Paul Shanley and Robert L. Collin (New England Deaconess Hospital, Boston). Radiation Research, 16: 674-8(May 1962).

Thermal expansion measurements and irradiation experiments with Co^{60} γ-rays were carried out on solid choline chloride at controlled temperatures between 30 and 90°C. G values for choline chloride decomposition drop markedly between 73 and 80°C, and it is in this same region that a phase transition is revealed by the thermal expansion measurements. This correlation suggests an intimate relation between the change in radiation sensitivity and the change in phase from an orthorhombic to a partially disordered cubic form. (auth)

17743 DECREASE OF RADIATION DAMAGE TO PROTEINS BY SULFHYDRYL PROTECTORS. U. S. Kumta, F. Shimazu, and A. L. Tappel (Univ. of California, Davis). Radiation Research, 16: 679-85(May 1962).

Radiation lability of amino acids of cytochrome c, hemoglobin, and egg albumin was studied under aerobic and anaerobic conditions and in the presence of –SH compounds. Aerobic irradiation causes considerable destruction of amino acids. Some protection was offered by anaerobic conditions and by –SH compounds used. Mechanisms by which the –SH compounds function as radiation protectors are discussed. (auth)

17744 CHEMICAL REACTIONS OF HCN UNDER THE INFLUENCE OF ^{60}Co-γ-RADIATION. D. Hummel and O. Janssen (Universität, Cologne). Z. physik. Chem. (Frankfurt), 31: 111-39(1962). (In German)

Polymerization of pure liquid HCN under the influence of γ radiation leads to the formation of azulmine with a G-value of 34. The degree of polymerization is about 16. Small amounts of acids result in a marked retardation of the polymerization reaction. Probably polymerization proceeds by a mixed anionic and radical mechanism. There is little influence of oxygen, indicating that radical polymerization plays a minor part. Two per cent of water doubles the G-value; ammonia formed by hydrolysis of the amidine-group in the azulmine effects a catalytic polymerization. This overlaps the radioinduced process and causes an after-reaction which sometimes results in an explosion. Small amounts of diaminomaleodinitrile as

a by-product were detected. The only gaseous products are nitrogen (to the maximum $^1/_{10}$ mol per mol azulmine) and a little hydrogen. (auth)

17745 PIERWIASTKI TRANSURANOWE. CHEMIA I TECHNOLOGIA. (Transuranium Elements. Chemistry and Technology). Mieczysław Taube. Warsaw, Publishing House of Scientific and Technical Literature, 1961. 360p.

In a text generously illustrated, containing a large number of tables and charts, and well referenced, the scientific and technological aspects of transuranic elements are presented. As an introduction, the nuclear properties of transuranic elements are reviewed. These include their existence in nature, their fissionability, and the synthesis of the transuranic isotopes by means of interactions with neutrons and with charged-particle bombardment. A treatment of radioactivity in this mass region includes transmutation of the elements by alpha and beta emission, spontaneous fission, the genetic series of transuranium radioactive decay, and a review of the radiometric techniques for obtaining the genetic series. The chemical properties of these elements are outlined, and include the properties of the free elements, metallic compounds, solids and physical properties of the solids, water solutions and organic solutions of the compounds, analytical methods, physiological effects of plutonium, and laboratory handling techniques. A thorough coverage of the uranium-plutonium fuel cycle is given, along with an introduction to fissionable fuels, their properties as fuel, a discussion of solid and liquid fuels, general burnup cycles and plutonium fuel cycles in particular. The chemical technology of spent uranoplutonium fuels is given a detailed treatment and covers the following areas: the general characteristics of spent-fuel processing, the technological processes preparing the materials, the general problems of separation, both low-temperature and high-temperature separation processes, the technology of pure plutonium, the safe disposition of radioactive materials and the technical aspects of fabrication plants. The economic problems are listed including fabrication personnel, the cost of building factories, of processing spent-fuel elements, the costs of exploitation, of obtaining plutonium, and of producing electrical energy. The methods of cost analysis for producing electrical energy are outlined separately. Finally, the prospects of plutonium utilization and general utilization of fissionable fuels are projected to the years 1975 and 2000 A.D. A breakdown in percentages of total world power utilization in 1) stationary power plants, 2) heat production, and 3) transportation. The present production rates of all the "actinides" is tabulated in a simplified listing at the end of the text. (TTT)

17746 CARBON-14 COMPOUNDS. John R. Catch. Washington, [D. C.,] Butterworths, 1961. 133p.

An account is given of all aspects of work with carbon-14 compounds. Information is given on the production, chemical synthesis, biological methods of labeling, analysis, measurement, precautions in the use, and peculiar features of carbon-14 compounds. The bibliographies after each section are extensive. (N.W.R.)

17747 RADIOCHEMICAL HYDROCARBON CONVERSION PROCESS. Barry L. Tarmy and Robert B. Long (to Esso Research and Engineering Co.). U. S. Patent 3,018,235. Jan. 23, 1962.

A conversion process is given for producing naphthenes and aromatics from isobutene. The process comprises irradiating a isobutene–isobutane mixture at –50 to +300°F in the presence of an acid oxide conversion catalyst such as silica-alumina, until a total dose of at least 10^4 r is received. Two examples of the process are given. (D.L.C.)

17748 RADIOETHYLATION OF PARAFFIN HYDROCARBONS. Peter J. Lucchesi and Barry L. Tarmy (to Esso Research and Engineering Co.). U. S. Patent 3,018,237. Jan. 23, 1962.

A hydrocarbon conversion process is given for upgrading refinery gases and light virgin naphtha to high-octane gasoline components. The process comprises irradiating a paraffinic hydrocarbon of 2 to 8 carbon atoms in the presence of 0.1 to 30 wt % ethylene at 500 to 800°F and 150 to 600 psig until a total dose of 10^{-4} to 10 kwh per pound of hydrocarbon feed is received. Several examples of the process are given in which the following paraffins were radioethylated: isobutane, n-butane, propane, and pentane. (D.L.C.)

17749 CHEMICAL PROCESS AND PRODUCT FORMED. Philip E. Lapat, Emanuel Gordon, and Robert B. Holden (to United Nuclear Corp.). U. S. Patent 3,019,139. Jan. 30, 1962.

A method is given for removing impurities from the surface of scrap metal chips of Ti, Hf, Zr, or an alloy thereof. The method is based on the operation of the pickling process within limits so that the precipitation of an insoluble oxyfluoride is prevented. The chips are treated in a pickling bath of HF and another inorganic acid under such conditions that the HF concentration is between 0.1 and 0.5 N, the concentration of the other acid is between 0.5 and 8 N, the temperature is between 20 and 60°C, and the Zr ion concentration in the bath is less than 1.6 M. The maximum permissible $[Zr^{2+}]$ may be calculated approximately from the equation $0.03T - 0.2C$, where T is the temperature (°C) and C is the concentration of mineral acid (N). Steps to take if oxyfluoride begins to be precipitated from the bath are given. (D.L.C.)

17750 RADIATION METHYLATION OF UNSATURATED HYDROCARBONS. Carl E. Heath, Jr. (to Esso Research and Engineering Co.). U. S. Patent 3,022,237. Feb. 20, 1962.

A process for radioinduced methylation of mono-olefins is given which is applicable to upgrading of refinery gases to high-octane gasoline components. In the preferred embodiment of the process, a mono-olefin of 2 to 7 carbon atoms is mixed with methane in a methane/olefin molar ratio of 9 : 1 to 200 : 1 and subjected to high-energy ionizing radiation at 650 to 900°F and a pressure of 10 to 55 atm until a total dose of 10^{-4} to 10 kwh per pound of hydrocarbon feed has been received. Several examples of the process are given in which ethylene was methylated. (D.L.C.)

17751 PROCESS FOR MAKING RADIOACTIVE IODINE. Geoffrey I. Gleason (to Abbott Labs., Inc.). U. S. Patent 3,033,652. May 8, 1962.

A process for producing I^{131} is given which uses meta-telluric acid. The telluric acid is irradiated with neutrons in a high-flux, low-temperature reactor and the resulting I^{131} is easily separated therefrom by distillation from acid solution. The advantages of meta-telluric acid over ortho-telluric acid are higher decomposition temperature and higher tellurium content. (D.L.C.)

17752 POLYSACCHARIDE EXTRACTION BY IRRADIATION. John R. Lowry (to General Foods Corp.). U. S. Patent 3,034,974. May 15, 1962.

A process is given for extracting gelatinous polysaccharides from raw materials in shorter times, at higher yields, and with improved properties. The process com-

prises subjecting the material to a beta or gamma dose of 0.5 to 4×10^6 rep and then carrying out the extraction in a conventional way. Two examples of the process are given which result in the separation of pectin from orange peel and alginic acid from seaweed. (D.L.C.)

Raw Materials and Feed Materials

17753 (AEC-tr-4941) ON THE REACTIVITY OF URANOURANIC OXIDE. II. THE REACTIVITY OF URANOURANIC OXIDES PREPARED BY THERMAL DECOMPOSITION OF URANYL NITRATE, AMMONIUM DIURANATE AND URANIUM PEROXIDE. Rokuo Ukaji (Ukazi). Translated from Nippon Genshiryoku Gakkaishi, 2: 117-21(1960). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 13723.

17754 CYCLIC OXIDATION-REDUCTION OF URANIUM OXIDES. A. F. Bessonov, V. G. Vlasov, and V. N. Strekalovskii. Zhur. Priklad, Khim., 35: 657-60(Mar. 1962). (In Russian)

Redox studies of uranium oxides at 20 to 500°C exhibited the presence of UO_2, UO_{2+3}, $UO_{2.25}$, $UO_{2.36+x}$, $UO_{2.64+x}$, and $UO_{2.67}$. The results are in good agreement with published data. (R.V.J.)

17755 LOW-TEMPERATURE CARBON-THERMAL OXIDATION REDUCTION OF URANIUM. V. G. Vlasov and V. A. Kozlov. Zhur. Priklad. Khim., 35: 660-3(Mar. 1962). (In Russian)

The kinetics of uranium thermal-carbon reduction at 625 to 725°C and the effects of sodium carbonate on the kinetics of U_3O_8 reaction with sugar carbon are studied. A preliminary introduction of soda into the oxide accelerated the process, however, an admixture of soda into carbon slowed the process. The activation energy with soda is 56 to 58 kcal/mole. (R.V.J.)

17756 CATALYTIC OXIDATION OF ORES. Daniel Chalmers McLean (to American Cyanamid Co.). U. S. Patent 3,017,241. Jan. 16, 1962.

A process for the recovery of U from ores by alkaline carbonate leaching is given in which the necessary U oxidation is effected by O_2 or air with ferricyanide ions as catalyst. The ferricyanide is formed by reaction of added cyanide with Fe introduced into the solution by the ball mill, and the ferrocyanide ions formed by oxidation of U are re-oxidized to ferricyanide under the conditions of U recovery from the ore. (D.L.C.)

17757 URANIUM RECOVERY PROCESS. James L. Hart (to Phillips Petroleum Co.). U. S. Patent 3,022,135. Feb. 20, 1962.

A process for the separation of U values from ores by carbonate leaching is given in which the method of separating Na_2SO_4 from a portion of the barren liquor after $Na_2U_2O_7$ precipitation is improved. The method of Na_2SO_4 separation consists of treating the liquor with anhydrous Na_2SO_4 and cooling to precipitate $Na_2SO_4 \cdot 10\ H_2O$. The regenerated barren liquor can then be recycled to the process. (D.L.C.)

17758 PROCESS FOR THE PREPARATION OF UF_3. William A. Jenkins and John H. Kennedy (to E. I. du Pont de Nemours & Co.). U. S. Patent 3,034,855. May 15, 1962.

A process is outlined for preparing UF_3 from aqueous solutions at room temperatures. The process comprises reducing an acid solution of a uranium compound in the presence of a zinc amalgam, separating the solution from the amalgam, and precipitating UF_3 by reaction with a fluoride solution. The initial solution should be at least 0.5 M acid and less than 0.2 M in uranium, and the process should be carried out in an inert atmosphere. The system should be free from any U^{4+}-complexing anion, and, in the precipitation of UF_3, the U^{3+} solution should be added to the fluoride solution and not vice versa to prevent precipitating an unstable uranium compound which is quickly oxidized to U^{4+}. (D.L.C.)

Separation Processes

17759 (DP-647) ELECTROLYTIC DISSOLUTION OF POWER REACTOR FUELS IN NITRIC ACID. A. Thomas Clark, Jr., Leon H. Meyer, J. Harding Owen, and Francis G. Rust (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 24p.

The electrolytic oxidation in nitric acid of stainless steel, zirconium, Zircaloy-2, zirconium–uranium alloy, aluminum, and uranium–molybdenum alloy was demonstrated on a laboratory scale. The rate of chemical dissolution of UO_2 in nitric acid was measured. Corrosion of stainless steel by these dissolver solutions was measured and found to be negligible. Electrolytic dissolution was demonstrated to be a practical technique for the first step in processing fuel elements of several types of power reactors. (auth)

17760 (DP-702) DISSOLUTION OF Pu–Al ALLOY. William C. Perkins (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1962. Contract AT(07-2)-1. 11p.

Irradiated Pu–Al alloy dissolved in HNO_3–$Hg(NO_3)_2$ at approximately the same rate as irradiated U–Al alloy. An average dissolving rate of 11 mg/(cm^2)(min) was measured in a solution that was initially 5M HNO_3–0.05M $Hg(NO_3)_2$. Dissolving rates increased as the initial acid concentration was decreased. Wide variations in dissolving rates were observed when different test pieces were dissolved in HNO_3–$Hg(NO_3)_2$ solutions, but the addition of 0.02M fluoride to the dissolver solution eliminated erratic behavior and resulted in rapid dissolution. (auth)

17761 (IDO-14579) SALT PHASE CHLORINATION OF REACTOR FUELS. IV. NIOBIUM BEHAVIOR IN THE LEAD CHLORIDE AND CHLORINE–LEAD CHLORIDE SYSTEMS. J. L. Teague, H. T. Hahn, and E. M. Vander Wall (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 15, 1962. Contract AT(10-1)-205. 20p.

Investigation of the behavior of Nb in $PbCl_2$ showed that the Nb dissolution rate is quite low. Since stirring increases the rate appreciably, it is likely that the initial reaction is diffusion controlled. A subsequent reaction is linear in rate with an activation energy of 23.4 kcal per mole. Incomplete volatilization of dissolved Nb from $PbCl_2$ is due to the presence of lower oxidation states of Nb. The addition of Cl to $PbCl_2$ increases the rate of dissolution of Nb. The rate is high enough at reasonable temperatures to be practical for fuel dissolution, e.g. 12 mg min^{-1} cm^{-2} at 550°C and 120 mg min^{-1} Cl. Volatilization of $NbCl_5$ is 99.9% complete at 550°C. (auth)

17762 (ORNL-3155) LABORATORY DEVELOPMENT OF THE ACID THOREX PROCESS FOR RECOVERY OF CONSOLIDATED EDISON THORIUM REACTOR FUEL. R. H. Rainey and J. G. Moore (Oak Ridge National Lab., Tenn.). May 11, 1962. Contract W-7405-eng-26. 29p.

The acid Thorex process, in which nitric acid is the "salting" agent in the solvent extraction of Th and U from an acid deficient feed with TBP in Amsco, was demonstrated in laboratory equipment for the recovery of synthetic Consolidated Edison Thorium Reactor fuel containing tracer fission products. The acid was removed from solution of the declad fuel pellets to produce an acid deficient feed by steam stripping, and the adjusted feed was treated with bisulfite to decrease the extractability of fission products. The Th and U were extracted with 30% TBP in Amsco, and pregnant organic was scrubbed with dilute nitric acid to improve decontamination. Additional acid was added to the extraction section to increase the distribution coefficient of the Th. The Th and U could then be stripped either simultaneously or separately. No difficulties were found with either excessive reflux of acid or Th, or with the formation of a second organic phase. Decontamination factors from Ru γ, Zr-Nb γ, Pa γ, and rare earth β were about 1000, 5000, 1000, and 10^5, respectively, and U and Th losses to the aqueous phase were <0.01 and <0.3%. The concentrated aqueous waste was about 0.2 liter per kilogram of Th processed, about $^1/_{10}$ of that from the aluminum nitrate-salted process. Engineering studies showed that the stage height in the extraction column with the acid Thorex process was 2.1 ft compared with 4 ft with the aluminum-salted Thorex process. (auth)

17763 (ORNL-TM-193) CHEMICAL PROCESSING OF COATED PARTICLE FUELS. Leslie M. Ferris (Oak Ridge National Lab., Tenn.). Apr. 3, 1962. Contract [W-7405-eng-26]. 9p.

Presented at Coated Particle Working Group Meeting, Oak Ridge National Lab., May 7-8, 1962.

Laboratory studies on the processing of graphite-base fuel elements containing pyrolytic carbon- or Al_2O_3-coated particles are reviewed. Potential processes for recovering U and Th from irradiated elements include grinding followed by acid leaching, and, burning and subsequent dissolution of the oxide ash. Disintegration in 90% HNO_3 was briefly evaluated as a method for determining the integrity of coated particles dispersed in graphite matrices. (auth)

17764 (AEC-tr-5014) AQUEOUS REPROCESSING OF URANIUM BY AMINE EXTRACTION. A. Chesne (France. Commissariat à l'Énergie Atomique, Paris). Translated from NP-9340 (Vol. III) (Sect. II) "Advanced Course on Fuel Elements for Water Cooled Power Reactors." 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5104.

17765 SOLVENT EXTRACTION IN THE SOUTH AFRICAN URANIUM INDUSTRY. P. J. Lloyd (Government Metallurgical Lab., Cape Town, South Africa). J. S. African Inst. Mining Met., 62: 465-80(Mar. 1962). (In English)

The possibility of the present resin ion exchange process for the recovery of uranium being replaced by solvent extraction on South African uranium plants is considered. Tests are described in which a suitable amine extractant is chosen and in which the optimum conditions for extraction and stripping processes using this solvent, are found. These data are used to obtain a preliminary estimate of the capital and operating costs for a solvent extraction plant which produces 600 tons of uranium per year. The operating cost is estimated to be sufficiently below that of an equivalent ion exchange plant to more than compensate for the capital required for the erection of the solvent extraction plant. Other advantages of solvent extraction are considered, and it is concluded that the results are sufficiently encouraging to warrant further investigation on a larger scale. (auth)

17766 SOLVENT EXTRACTION OF METALS BY ORGANOPHOSPHORUS COMPOUNDS. II. PARTICULAR EXTRACTION SYSTEMS. Keiichi Oshima (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 166-74(Mar. 1962). (In English)

The systematic study on the basic mechanism of extraction for the systems of TBP-acids, TBP-U-acids, and TBP-metals-HNO_3 was carried out, and the factors affecting the extractability in these systems were discussed. The extraction of uranium by organophosphorus compounds with different chemical structure was also studied, and the extractability of these solvents was shown to be partly explainable by the electronic theory of organic chemistry. Several applications and solvents were proposed. (auth)

17767 HAFNIUM NITRATE COMPOUNDS WITH TRIBUTYL PHOSPHATES. I. A. Sheka and S. A. Kacherova (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukrain. Khim. Zhur., 28: 38-42(1962). (In Russian)

A solvent extraction of hafnium nitric acid solutions by TBP-benzene solution resulted in anhydrous $Hf(NO_3)_4 \cdot 2TBP \cdot n\ HNO_3$. (R.V.J.)

17768 SEPARATION OF Li^+, Na^+ FROM Mg^{2+}, Ca^{2+} AND Al^{3+} BY ION EXCHANGE METHOD. R. N. Golovatyi, M. I. Novosel'skaya, and V. V. Oshchapovskii (L'vov State Univ.). Ukrain. Khim. Zhur., 28: 112-15(1962). (In Russian)

Effects of hydrochloric acid concentration on the elution rate of Li^+, Na^+, Mg^{2+}, Ca^{2+}, and Al^{3+} sorbed by KU-2 cation resin were studied. Within the studied limits (up to 1 mg-eq) Li^+ and Na^+ do not effect the elution curve. The consumption of acid increases with increased height of the resin column. A chromatographic method was used for Li^+ and Na^+ separation from Mg^{2+}, Ca^{2+}, and Al^{3+}. The method was verified with artificial mixtures and silicate materials. (R.V.J.)

17769 DISTRIBUTION OF MOLYBDENUM AND TUNGSTEN IN THE SYSTEM HYDROBROMIC ACID–ORGANIC SOLVENT. F. G. Zharovskii and A. G. Sakhno (Kiev State Univ.). Ukrain. Khim. Zhur., 28: 145-50(1962). (In Russian)

Distribution of Mo and W between hydrobromic acid and ionic acid-containing organic solvents was studied. It was found that with increased acid the extraction of W decreases and the extraction of Mo increases. Extraction of W from 1.0 n hydrobromic solution by given solvents increases accordingly: isoamyl acetate < isobutynol > isoamyl alcohol > diethyl ether > n-amyl alcohol > isobutyl acetate > propyl acetate. For Mo at identical acidity the solvents follow another order: diethyl ether < isobutyl acetate < propyl acetate < isoamyl acetate < isoamyl alcohol < n-amyl alcohol < isobutanole < butanol. The molar ratio of isoamylacetate extracted molybdenum (tungsten complex) is Mo : Br = 1 : 2. (R.V.J.)

17770 POLAROGRAPHIC INVESTIGATION OF OXIDES OF ZINC, GERMANIUM, CHROMIUM, MOLYBDENUM AND TUNGSTEN ON A BACKGROUND OF FUSED BORAX. G. V. Shilina and N. V. Ul'ko (Kiev State Univ.). Ukrain. Khim. Zhur., 28: 172-9(1962). (In Russian)

Polarographic behavior of ZnO, GeO, MoO_3, Cr_2O_3, and WO_3 in molten borax was investigated and the maximum concentrations forming polarographic waves were found. The expression $i_d = K \cdot N$ was confirmed for melts contain-

ing ZnO, GeO, and MoO_3 at certain concentration limits. The curves in semi-logarithmic coordinates, $E - \lg i/(i_d - i)$, for the examined melts are nearly straight line. The reduction of WO_3 and Cr_2O is step-line, and a direct ion reduction to metal was observed in electrolysis of systems with ZnO, GeO_2, and MoO_3. (R.V.J.)

17771 SEPARATION OF RARE EARTHS BY HYDROXYL ANIONITES. A. I. Ryabinin and Yu. A. Koz'min (Inst. of Mining and Metallurgy of Non-Ferrous Metals, USSR). Zhur. Priklad. Khim., 35: 499-503 (Mar. 1962). (In Russian)

Studies were made of La separation by anion-exchange with hydroxyl ions. The results showed that EDE-10 anionite in hydroxyl form is the most effective for La. Other resins tested (AN-1, AN-18, and AN-23) cannot be utilized. (R.V.J.)

17772 METHOD OF REFINING METALS. Karl J. Korpi and Raymond C. Johnson (to Lummus Co.). U. S. Patent 3,015,555. Jan. 2, 1962.

A method for producing high-purity refractory metals, e.g., Ti, Zr, Hf, V, and U, is given which uses disproportionation of lower iodides of the metals. The method is described with reference to Ti. Ore containing Ti is pulverized and reduced with powdered C, and the reduction product is reacted with TiI_4 and/or TiI_3 to form TiI_2. The TiI_2 in liquid state is then disproportionated to form solid Ti and gaseous TiI_4, the latter which is recirculated for reaction with reduced ore. The method is identical with that described in U. S. Patents 3,015,556 and 3,015,557, except for the halogen used. (D.L.C.)

17773 METHOD OF REFINING METALS. Karl J. Korpi and Raymond C. Johnson (to Lummus Co.). U. S. Patent 3,015,556. Jan. 2, 1962.

A method for producing high-purity refractory metals, e.g., Ti, Zr, W, Hf, and U, is given which uses disproportionation of lower bromides of the metals. The method is described with reference to Ti. Ore containing Ti is pulverized and reduced with powdered C, and the reduction product is reacted with $TiBr_4$ and/or $TiBr_3$ to form $TiBr_2$. The $TiBr_2$ in liquid state is then disproportionated to form solid Ti and gaseous $TiBr_4$, the latter which is recirculated for reaction with reduced ore. The method is identical with that described in U. S. Patents 3,015,555 and 3,015,557, except for the halogen used. (D.L.C.)

17774 METHOD OF REFINING METALS. Karl J. Korpi and Raymond C. Johnson (to Lummus Co.). U. S. Patent 3,015,557. Jan. 2, 1962.

A method for producing high-purity refractory metals, e.g., Ti, Zr, and U, is given which uses disproportionation of lower chlorides of the metals. The method is described with reference to Ti. Ore containing Ti is charged to a pulverizer and reduced by powdered C in a furnace. The reduction product is then reacted with $TiCl_4$ and/or $TiCl_3$ in a first reactor to form $TiCl_2$, and the $TiCl_4 + TiCl_2$ mixture is condensed to form a liquid $TiCl_2$ pool in a second reactor heated to 725 to 1475°C to bring about the disproportionation reaction $2\ TiCl_2(l) \rightarrow Ti(s) + TiCl_4(g)$. The gaseous $TiCl_4$ is recirculated to the first reactor. The method is identical with that described in U. S. Patents 3,015,555 and 3,015,556, except for the halide used. (D.L.C.)

17775 PROCESS FOR THE PREPARATION OF NIOBIUM OXIDE. Bernard Desbois and Jean de Maurienne (to Pechiney, Compagnie de Produits Chimiques et Electrometallurgiques). U. S. Patent 3,024,087. Mar. 6, 1962.

A process is outlined for preparing pure Nb_2O_5 from an aqueous solution containing Nb compounds in anionic form and compounds of metals of the III, IV, V, and VIII groups of the periodic table, particularly Fe. The process comprises contacting the solution with an anionic exchange resin and eluting the sorbed metals with an aqueous NaCl solution; Fe is eluted before Nb, and the resin is regenerated. An example of the process is given in which Nb_2O_5 of spectrographic purity was prepared from a HF solution containing Nb, Ta, Fe, Mn, Ti, Si, Cu, Al, and Sn. (D.L.C.)

17776 METHOD OF SEPARATING RARE EARTH METAL IONS. Robert D. Hansen (Dow Chemical Co.). U. S. Patent 3,033,646. May 8, 1962.

A method for separating rare earth metal ions by cation exchange is given. The method comprises sorbing the metal ions on the hydrogen form of a sulfonic acid type cation exchange resin, eluting the metals from the resin with a 0.01 to 0.1 M aqueous solution of an alkali salt of diethylenetriamine pentaacetic acid, and collecting successive fractions of the effluent liquid. The resin preferably should swell appreciably in water and should consist of sulfonated copolymers of 96 to 94% of monovinyl aromatic hydrocarbons and 4 to 6% divinylbenzene. Several examples of the method are given. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

17777 (AERE-CE/R-1828) ASSESSMENT OF THE SUPERCENTRIFUGE AS A MEANS OF PARTICLE SIZE ANALYSIS. D. Bradley (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1, 1956. Reprinted Mar. 1962. 18p.

Centrifugal methods of particle size analysis are reviewed, and the use of the Sharples Laboratory "Super-Centrifuge" for analysis in the size range from 2 to 0.1 μ is critically assessed. (auth)

17778 (EURAEC-99) CAN-1—QUARTERLY PROGRESS REPORT, OCTOBER 16, 1960 TO MARCH 15, 1961. PART A. TECHNICAL REPORT. (Ansaldo S.p.A., Genoa). Mar. 25, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract [003-60-IRDI]. 50p. (LAB/STU-1451)

Final results of the air-water separation experiments are presented. A detailed description of the high-pressure loop and its instrumentation is given. The efficiency of the separators giving the best results ranged from 96 to 100%. Diagrams and tables are included. (M.C.G.)

17779 (TID-15483) AUTOMATIC LIQUID NITROGEN PUMPING SYSTEM. Matti K. Salomaa (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [Apr. 9, 1962]. Contract [AT(30-1)-2098]. 13p.

Design of a system to control the liquid N in traps associated with diffusion pumps is described. The system was designed for use with three pumps, however it can be extended to any number of pumps. (J.R.D.)

17780 (TIM-5) DESIGN PROCEDURE FOR SODIUM TO NaK HEAT EXCHANGER. H. C. Hopkins (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Feb. 25, 1954. Contract [AT(11-1)-229]. 48p. (FXM-669)

A procedure is presented for determining the design of heat exchangers for use in transferring heat from Na to NaK in the CLF reactor. (J.R.D.)

17781 (SCL-T-417) HERMETIC (AIRTIGHT) MOLYBDENUM TO GLASS "SOLDER" SEALS. H. Adam. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Vakuum-Tech., 8: No. 3, 59-62(Apr. 1959). 9p.

It is possible to produce industrially hermetic (airtight) "solder"-like or fusion-type seals between molybdenum and glass, using large dimensions. The technique suggested is described in detail for the following examples: single-rod and the annular seals. In both cases, no protective hydrogen atmosphere is required, simplifying in particular the manufacturing production process for ring seals. Experience was obtained in sealing (fusing) molybdenum rods with up to 10 mm in diameter and annular seals with up to 75 mm diameter in matched glasses. The procedure described can also be applied to seals of even larger dimensions without major modifications. (auth)

17782 AXIAL SOLID DISTRIBUTION IN GAS-SOLID FLUIDIZED BEDS. Liang-Tseng Fan, Chau Jen Lee, and Richard C. Bailie (Kansas State Univ., Manhattan). A.I.Ch.E. Journal, 8: 239-44(May 1962).

A γ-ray attenuation method was applied to determine the axial fluidizing bulk density profile for an air-solid aggregative fluidized bed. Except for beds fluidized at very high air velocities two distinct density zones were noted. The density of the bed in the lower portion of the column was relatively constant for a particular set of operating conditions and did not vary with bed height. The density in the top portion of the bed fell rapidly with bed height. The average density of the lower zone was correlated as a function of the operating variables. The density in the top zone was represented by a one-tail normal distribution curve. A somewhat better correlation was obtained by a two-parameter equation at high air velocities. The effects of operational variables, such as air velocity, static bed height, particle size, and particle-size distribution on these correlations were investigated. Friction-factor correlations based on two different definitions of bed height were also obtained. (auth)

17783 TRANSPORT CHARACTERISTICS OF SUSPENSIONS: PART IV. FRICTION LOSS OF CONCENTRATED-FLOCCULATED SUSPENSIONS IN TURBULENT FLOW. David G. Thomas (Cambridge Univ., Eng.). A.I.Ch.E. Journal, 8: 266-71(May 1962).

Turbulent flow friction factors were determined for flocculated suspensions of thoria, kaolin, and titania in tubes ⅛- to 1-in. diameter. The non-Newtonian laminar flow data were arbitrarily fitted with the Bingham plastic model. With this model the range of yield stress values was 0.018 to 1.39 ft-lb/ft^2, with a maximum ratio of coefficient of rigidity to viscosity of suspending medium of 11.1. The volume fraction solids were varied from 0.042 to 0.23. Two types of behavior were observed depending on the value of the yield stress. For yield values less than 0.5 ft-lb/ft^2 the turbulent fraction factors were always less than those for Newtonian fluids but tended to approach the Newtonian values as the Reynolds number was increased. For yield values greater than 0.5 ft-lb/ft^2 the friction factors were again less than those for Newtonian fluids but tended to diverge from the Newtonian values as the Reynolds number was increased. Both sets of data were correlated with the Blasius relation with the coefficient and exponent given in terms of the laminar flow properties and the volume fraction solids. (auth)

17784 INFRARED TECHNIQUES FOR TEMPERATURE MEASUREMENT IN PLASMAJETS. Richard H. Tourin (Warner and Swasey Co., Flushing, N. Y.). J. Heat Transfer, 84: 164-8(May 1962).

The application of monochromatic radiation pyrometry to measurement of plasma temperatures was investigated. Infrared emission and absorption spectra of N, Ar, and He plasmajets, with various admixtures, were measured. Strong infrared emission was observed in various lines and bands in the plasma spectra, extending from the visible region to 7.0 μ. The observed infrared absorption was generally low. Temperatures measured ranged from below 2000°K for a N_2 plasmajet heavily seeded with CO_2, to 13,000°K for pure Ar. Temperature gradients in a plasmajet were inferred from observations made through various regions of the jet. (auth)

17785 THERMOCOUPLE ATTACHMENT TO A DIRECT-CURRENT HEATER. M. E. Davenport, P. M. Magee, and G. Leppert (Stanford Univ., Calif.). J. Heat Transfer, 84: 187-8(May 1962).

A calibration method is outlined for measuring to within ±0.1 mv (5°F) the extraneous component of the thermocouple signal from a d-c heater. A differential thermocouple is formed with one junction welded onto the test section of the heater and the other junction in a small electric furnace at a steady temperature near that of the thermocouple being calibrated. A steady heating current of up to 300 amp is passed through the test section while the differential thermocouple emf and heating currents are recorded on an oscillograph, and then the current flow is suddenly interrupted. The resulting change in the thermocouple emf is the extraneous signal, which varies linearly with heating current and is independent of temperature. (D.L.C.)

17786 LEVITATION MELTING OF BERYLLIUM. A. B. Miller (C. A. Parsons and Co., Ltd., Newcastle-upon-Tyne, Eng.). J. Nuclear Materials, 5: 344-6(Apr.) 1962). (In English)

A design is presented for an apparatus for levitation melting of Be. The arrangement provides a quick method for preparing small contamination-free samples of Be and its alloys for metallographic studies. (C.H.)

17787 INERT ATMOSPHERES IN THE CHEMICAL, METALLURGICAL AND ATOMIC ENERGY INDUSTRIES. P. A. F. White and S. E. Smith. Washington, [D. C.,] Butterworths, 1962. 242p. $9.00.

The developments and basis for the selection of suitable methods and processes as well as the design of appropriate plants for producing protective atmospheres are outlined. The developments are primarily concerned with improved purity, integrity, and economy in inert atmosphere plants. (N.W.R.)

17788 ELECTROMAGNETIC PUMPS. William George Hutchinson and Leslie Charles Cole (to United Kingdom Atomic Energy Authority). U. S. Patent 3,015,278. Jan. 2, 1962.

An electromagnetic pump of the induction type is designed for use with radioactive liquid metals. The electrical parts of the pump can be withdrawn for maintenance by remote handling. (D.L.C.)

17789 METHOD AND APPARATUS FOR CONTINUOUSLY TREATING POWDER COMPOSITIONS SUCH AS POWDER METALS. Jacques Humbert, Jacques Dubuisson, and Claude Moranville (to Commissariat à l'Énergie Atomique). U. S. Patent 3,025,156. Mar. 13, 1962.

A method and an apparatus are described for the continuous preparation of powder metals by reduction of a metal compound. The apparatus comprises a tubular casing adapted to receive a rigid column of stacked crucibles at one end for discharge from the other end and including gas seals, a furnace, and cooling units. In the method, a mixture of the metal oxide and a reducing agent, e.g., Ca, is pressed into cakes and each cake reacted by passing through the casing in a crucible. An example of the method is given in which U and Th powders were prepared by Ca reduction of UO_2 and ThO_2. (D.L.C.)

17790 GAS LUBRICATED JOURNAL BEARING ASSEMBLIES. Allan Barker (to United Kingdom Atomic Energy Authority). U. S. Patent 3,034,837. May 15, 1962.

A gas-lubricated journal bearing assembly is designed so that, in the event of gas lubrication failure, the bearing can continue to operate without creating a large leakage path in the sealing means. The assembly consists of a journal member and a journal bearing member, one of the members comprising a base part with a coaxial sleeve joined to it by an annular sealing part. In normal operation, gas lubrication is sustained between the sleeve part and the other member of the assembly. In the event of bearing seizure, relative rotation between the sleeve part and its base part can take place by slip at the annular sealing part. (D.L.C.)

17791 MEANS FOR AND METHOD OF GENERATING ELECTRICAL AND MAGNETIC PULSES. Frank J. Fishman, George Sargent Janes, Arthur R. Kantrowitz, and Harry E. Petschek (to Avico Manufacturing Corp.). U. S. Patent 3,035,206. May 15, 1962.

A magnetic pulse generator is described which may be used to accelerate gases rapidly and thus produce temperatures on the order of 10^6°K. The generator has a device for inductively storing electrical energy and for suddenly discharging the energy through an associated load. The sudden discharge is effected by fusible links which are destroyed by current flow in excess of a certain value. The application of the generator to the acceleration of ionized hydrogen gas is discussed. (D.L.C.)

Heat Transfer and Fluid Flow

17792 (AFOSR-1591) THE MEASUREMENT AND COMPARISON WITH THEORY OF HEAT TRANSFER FROM SIMILAR LAMINAR BOUNDARY LAYERS TO AERODYNAMIC BODIES IN SUPERSONIC AND HYPERSONIC GAS STREAMS. Report No. 569. William G. Reinecke (Princeton Univ., N. J.). Oct. 1961. Contract AF29(638)-465. 170p.

The experimental measurement of small rates of heat transfer to wind tunnel models from laminar compressible similar boundary layers at supersonic and hypersonic free stream Mach numbers is described. Wind tunnel models are developed having specified surface Mach number distributions. A method is developed and tested for measuring isothermal heat transfer to cold wind tunnel models. Measurements are made of the recovery temperature and heat transfer rates on cold and hot models respectively with similar boundary layers in both favorab'e and adverse pressure gradients at free stream Mach numbers of two and eleven respectively. A correction based on exact solutions for arbitrary Prandtl numbers is used to accommodate the similar solutions, assuming a Prandtl number of one for the test gases. In tests carried out in the Mach-two free stream, agreement is obtained between theory and experiment except in a region where the similarity requirement on the surface Mach number distribution is singular. The tests in the adverse pressure gradient suggest that the upper-branch similar solutions are encountered in practice. The recovery temperatures are found to agree with values predicted by equating the local recovery factor to the square root of the Prandtl number. (auth)

17793 (EURAEC-34) IMPROVEMENT OF HEAT TRANSFER IN BOILING WATER REACTORS. Quarterly Report No. 2, July–September 1960. C. Foure (Société Nationale d'Étude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). Oct. 26, 1960. Work performed under United States–Euratom Joint Research and Development Program. Contract [017-60-4RDF]. 17p.

Discussions are given of work done on two-phase discharges with single vortex, water-steam separation, and thermal tests with single vortex freon and water. (B.O.G.)

17794 (EURAEC-49) DESIGN AND CONSTRUCTION OF A FACILITY FOR AIR–WATER MIXING AND SEPARATION EXPERIMENTS. Special Report No. 1. (Ansaldo S.p.A., Genoa). June 10, 1960. Work performed under United States-Euratom Joint Research and Development

Program. Contract [003-60-1RDI]. 88p. (LAB/STU-1416).

A description is given of the mixers, separators, and allied equipment designed for use in providing fog-cooling by means of steam–water mixtures in dispersed flow for light water moderated power reactors. (B.O.G.)

17795 (EURAEC-54) STUDY OF TWO-PHASE ADIABATIC FLOWS. SINGLE VORTEX. Special Report No. 2. A. Mihail and B. Bernard (Société Nationale d'Étude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). Dec. 21, 1960. Work performed under United States–Euratom Joint Research and Development Program. Contract [017-60-4RDF]. 64p.

Activities are reported in a program to develop reactor tubes in which vortex-type flow occurs. Such flow is created by twisted tapes or jets. Experiments are described on liquid flow and two-phase flows. Results indicate that the product of the liquid velocity by the hydraulic diameter remains about constant. Further study recommendations are made. (J.R.D.)

17796 (EURAEC-105) RESEARCH PROGRAMME ON HEAT TRANSFER IN A BOILING WATER REACTOR. Quarterly Report No. 1, December 1960–March 1961. (Eindhoven, Netherlands. Technische Hogeschool). Work performed under United States–Euratom Joint Research and Development Program. Contract [032-60-11RDA]. 43p.

Activities in a program to investigate heat transfer and stability in a boiling water circuit are described. Included are descriptions of the pressurized boiling loop and the atmospheric pressure glass loops in operation. Results of preliminary experiments on Halden reactor fuel elements concerning heat losses and entrance losses are included. (J.R.D.)

17797 (EURAEC-108) STATISTICAL METHODS FOR HOT CHANNEL AND HOT SPOT CALCULATION. Progress Report No. 1, November 1960–March 1961. (FIAT. Sezione Energia Nucleare, Turin). Apr. 28, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 035-60-11-RDI. 66p. (FN-E-4)

An outline of research activities planned concerning reactor hot channel and hot spot problems is presented. The program is to investigate correction factors, statistical aspects of each subfactor, aspects of nuclear subfactors, and aspects of engineering subfactors. (J.R.D.)

17798 (EURAEC-145) INFLUENCE OF CENTRIFUGAL TWISTED TAPES ON FREON BURN-OUT FLUX. Review of Test. Special Report No. 4. (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). June 27, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract [017-60-RDF]. 72p.

Activities in a program to obtain preliminary results on the heat transfer improvement in boiling liquids through vortices induced by twisted tapes are described. The installation and operation of a large hot water test loop is also described. Freon was used in the boiling liquid heat transfer tests, the data from which are for use in preparing tests in the boiling water loop. (J.R.D.)

17799 (EURAEC-209) FINAL RESULTS OF STEAM–WATER MIXING AND SEPARATION EXPERIMENTS: PHASES DISTRIBUTION AND SEPARATION EFFICIENCY. Final Report, July 15–September 15, 1961. S. Vella (Ansaldo S.p.A., Genoa) and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). Oct. 15, 1961. Work performed under United States–Euratom Joint Research and Development Program. 109p. (LAB/STU-1469)

Results of steam–water experiments are presented along with a description of experimental conditions. It was found that the ratio of the local mass velocities in the mixture and the average mass velocity of the mixture depends on the average steam quality. Data on phase distribution under average inlet conditions are presented graphically. Results of the separation investigations confirm results obtained in air–water experiments. (J.R.D.)

17800 (GEAP-3562) STEAM CARRYUNDER MEASUREMENT BY MEANS OF TWO-PHASE PUMP PERFORMANCE. R. O. Niemi and A. G. Steamer (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Oct. 5, 1960. 30p.

Pump tests were conducted at the Moss Landing Steam Separation Facility at operating pressures of 600 and 1000 psig to provide a method for determining the rate of steam carryunder. Pump power input and head were measured as functions of water flow and steam flow to the pump suction. The pump tested had a rated flow of 1700 gpm and a rated head of 148 feet. It was found that in this facility, steam carryunder can be measured to 0.1% by measuring the recirculating water pump input power and pump head. (auth)

17801 (TIM-384) FUNCTION SCALES AND NOMOGRAPHS FOR THE CALCULATION OF AIR PRESSURE DROP THROUGH A CONSTANT AREA HEATED PASSAGE. Paul G. Kvick (Pratt and Whitney Aircraft Div., United Aircraft Corp., [Hartford, Conn.]). Feb. 26, 1957. Contract [AT(11-1)-229]. 20p.

The problem of determining the pressure drop in a constant area heated passage for air was approximately solved by assuming that air is a perfect gas, that the isentropic relations between static and stagnation conditions at any point of the flow are satisfied, and that the mass flow rate is constant. Under these conditions the momentum equation takes a form which may be integrated to yield the static pressure drop when the mean value of the specific volume of the air in the passage is known. By using the geometric mean of the inlet and exit specific volumes as an estimate of the true mean, a fourth degree polynomial is obtained. The ratio of exit total pressure to inlet total pressure may be expressed as a function of the least positive root of this equation. Function scales and nomographs were constructed to ease the task of computing the coefficients of the polynomial and the value of the total pressure ratio corresponding to its least positive root. (auth)

17802 (TIM-552) FORCED CONVECTION LIQUID METAL INPILE LOOP HYDRODYNAMIC TEST OF THE LIQUID METAL CIRCUIT. C. R. Nelson and J. M. Reynolds (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Dec. 5, 1958. Contract [AT(11-1)-229]. 26p.

A hydrodynamic study is described concerning a full-scale mock-up of the PW-19 forced convection in-pile loop conducted with the in-pile loop cold flow test unit. All of the results were obtained with the use of a fiberglass model of the in-pile loop pump impeller. (J.R.D.)

17803 (TIL/T-5028) ENTRAINMENT OF LIQUID BY GAS OR STEAM. G. A. Uvarov. Translated from Sbornik Nauch. Trudov, Kuĭbyshev, Ind. Inst. im. V. V. Kuĭbysheva, No. 5, 196-203(1955). 8p. (AD-235547)

Calculations were made of the quantity of liquid entrained by gas or steam during its movement in a free space. The equation for the motion of a bubble of the gas in a suffi-

ciently large space is given. For examining phenomena in liquid disturbed by the motion of a body immersed in it, the assumption was made that the body remains at rest while the flow of liquid takes up the motion. Determination of the thickness of displacement for a bubble of gas is discussed. Equations are given for determining the volume of the body of rotation. (M.C.G.)

17804 RESEARCHES ON ADIABATIC TWO-PHASE FLOW. I. Casagrande, L. Cravarolo, and A. Hassid (CISE, Milan). Energia nucleare (Milan), 9: 148-59 (Mar. 1962). (In Italian)

The possible utilization of steam-water mixtures as reactor coolants requires extensive information on the involved phenomena and particularly on the fluid-dynamics of two-phase flow. The researches performed at CISE on adiabatic vertical two-phase flow are breifly reported and the main results discussed. The experiments were carried out mainly at room temperature and at a pressure of ~22 kg/cm^2 with argon-water mixtures flowing in dispersed regime in a circular vertical conduit, 25 mm ID. The flow rate ranges were: 18–205 g/(cm^2 s) (liquid) and 16–95 g/(cm^2 s) (gas). However experiments were carried out also with other fluids and lower pressures, as well as different geometries. The main quantities measured are: thickness of the liquid film adhering to the conduit wall, phase and velocity distribution, pressure drops, and pressure oscillations. (auth)

17805 MEASUREMENTS OF DIABATIC FLOW IN AN ANNULUS WITH AN INNER ROTATING CYLINDER. K. M. Becker (Swedish Atomic Energy Co., Stockholm) and Joseph Kaye. J. Heat Transfer, 84: 97-105 (May 1962).

The second phase of an investigation of the phenomena and variables which control the rate of heat transfer in the air gap of a rotating electrical machine is reported. Experimental data for diabatic flow in an annulus are summarized and compared with the results of previous studies. The data are examined in terms of the types of flow processes occurring in an annulus, and it is found that the results for diabatic flow clearly confirm those obtained for adiabatic flow in showing the existence of three, and possibly four, modes of flow in this annulus. These modes are: (1) Laminar flow; (2) laminar-plus-Taylor-vortexes flow; (3) turbulent flow; (4) turbulent-plus-vortexes flow. The heat-transfer data were subdivided into the following two limiting cases and one general case: (1) axial flow with zero rotation; (2) rotation of inner cylinder with zero axial flow; (3) general case of combined axial flow and rotation. The heat-transfer data from this study and of previous investigations were correlated in terms of Reynolds number and Taylor number over a wide range of these variables in terms of fairly simple equations. Radial temperature profiles in the annular gap were measured for the diabatic flow and aided in the understanding of the different flow phenomena in the annulus with an inner rotating cylinder. (auth)

17806 THE INFLUENCE OF A RADIAL TEMPERATURE GRADIENT ON THE INSTABILITY OF FLUID FLOW IN AN ANNULUS WITH AN INNER ROTATING CYLINDER. K. M. Becker (Swedish Atomic Energy Co., Stockholm) and Joseph Kaye. J. Heat Transfer, 84: 106-10 (May 1962).

The problem of instability of diabatic flow between rotating, concentric cylinders was studied analytically. The basic equations were reduced to a form identical to that of a similar instability fluid flow problem, namely, the instability of a horizontal layer of fluid heated from below. The latter problem has been solved by Pellew and Southwell, and their solution was used to calculate and predict the instability of diabatic flow in the annulus. The results of the analysis show that heating of the inner rotating cylinder stabilizes the flow, while heating of the outer stationary cylinder destablizes the flow. (auth)

17807 FORCED CONVECTION HEAT TRANSFER FROM A UNIFORMLY HEATED SPHERE. W. S. Brown (Utah Research and Development Co., Salt Lake City), C. C. Pitts, and G. Leppert. J. Heat Transfer, 84: 133-40 (May 1962).

An approximate analytical solution is presented for the variation of the local heat-transfer coefficient over the forward half of a uniformly heated sphere. Experimental measurements with water over a Reynolds number range of 5000 to 480,000 and a Prandtl number range of 2.2 to 6.8 give local coefficients which are in good agreement with analytical results. Average heat-transfer coefficients for the uniformly heated sphere are slightly higher than similar results reported earlier for an isothermal sphere. The effect of variations of heat flux on the average heat-transfer coefficient is correlated in a manner similar to that which was used for the isothermal data. Three different duct sizes were used in the experiment to determine the effect of this variable, and the correlations which are presented are based on duct-to-sphere diameter ratios of 2, 2.67, and 4. (auth)

17808 TRANSIENT, LAMINAR, COMBINED FREE AND FORCED CONVECTION IN A DUCT. S. L. Zeiberg (City Coll. of New York, New York) and W. K. Mueller. J. Heat Transfer, 84: 141-8 (May 1962).

Transient, laminar, combined free and forced convection in a duct is analyzed under the assumptions of constant fluid properties and fully developed flow. The transient heating is taken to be a result of wall temperature variations; the wall temperatures vary linearly with the axial co-ordinate of the duct (this is shown to be the only permissible axial dependence, other than no wall temperature variation in the axial direction). Numerical results show that for certain combinations of the Prandtl and Rayleigh numbers, an oscillatory approach to steady state exists. This phenomenon can induce a large reduction of the Nusselt number (compared to steady state) during the transient period. (auth)

17809 THE EFFECT OF SUBCOOLED LIQUID ON LAMINAR FILM BOILING. E. M. Sparrow (Univ. of Minnesota, Minneapolis) and R. D. Cess. J. Heat Transfer, 84: 149-56 (May 1962).

Heat-transfer results for film boiling in the presence of a subcooled liquid were determined analytically for the case of the isothermal vertical plate. The two-phase flow and heat-transfer problem which arises was formulated exactly within the framework of boundary-layer theory, and free convection within the liquid was accounted for. At a fixed temperature difference between surface and saturation, the effect of subcooling is to increase the heat transfer from the plate surface, with the magnitude of the increase being controlled by five physical parameters. Graphical presentation of the heat-transfer results is made for parametric values which correspond to water, but this information may be applied to other fluids having similar parameter ranges. For large subcooling, the heat transfer is essentially equal to that for pure free convection (no boiling), and the limits for this condition are given. (auth)

17810 LAMINAR FLOW HEAT TRANSFER FOR VARIABLE PHYSICAL PROPERTIES. L. B. Koppel (Purdue Univ., Lafayette, Ind.) and J. M. Smith. J. Heat Transfer, 84: 157-63 (May 1962).

A solution is presented for heat transfer from a circular

tube to a fluid, with variable properties, in fully developed laminar flow within the tube. The major assumption employed is that the radial velocity component may be neglected. The method is illustrated for supercritical carbon dioxide with the boundary condition of constant wall heat flux. Under these conditions, the density and thermal properties vary greatly with temperature. The results indicate that unusual behavior of the heat-transfer coefficient may occur for certain values of heat flux and fluid temperature. The new solution technique presented should be applicable to a variety of partial differential equations with variable coefficients. (auth)

17811 HEAT TRANSFER TO AIR IN A CIRCULAR TUBE HAVING UNIFORM HEAT FLUX. C. A. Depew (Univ. of Washington, Seattle). J. Heat Transfer, 84: 186-7 (May 1962).

Results are reported for heat transfer measurements in a tube with a fully developed velocity profile at the inlet. Air-to-wall temperatures were moderate, and the Reynolds number was varied from 11,400 to 41,400. The variation of the local heat-transfer coefficient with axial distance agrees well with Sparrow's profiles, and the Nusselt number was found to fit within ±5% Sparrow's equation $Nu_\infty = 0.0245\ Re^{0.77}$ for Pr = 0.7. (D.L.C.)

17812 FORCED CONVECTION BOILING IN TUBES. V. E. Schrock and L. M. Grossman (Univ. of California, Berkeley). Nuclear Sci. and Eng., 12: 474-81 (Apr. 1962).

Local heat transfer coefficients and pressure gradients were measured for bulk boiling of water in forced flow (vertically upward) in round tubes with internal diameters ranging from 0.1162 to 0.4317 in., lengths of 15 to 40 in., heat fluxes of 6×10^4 to 1.45×10^6 Btu/hr ft^2, mass fluxes of 49 to 911 lb/sec ft^2, exit qualities of 5 to 57%, and at pressures ranging from 42 to 505 psia. The local heat transfer coefficients expressed in the form of the Nusselt number were correlated in terms of Reynolds and Prandtl numbers and two dimensionless groups characterizing forced convection vaporization, the Lockhart-Martinelli parameter X_{tt}, and the boiling number, $Bo = (q/A)/Gh_{fg}$. For large values of the latter, nucleate boiling predominates and the dependence of the heat transfer on X_{tt} is small. Conversely, at the small values of Bo, convective flow effects are dominant, and there is a strong dependence on X_{tt}. (auth)

Instrumentation

Refer also to abstract 17575.

17813 (AD-263107) PHOTOEMISSION SOLAR ENERGY CONVERTER. Semiannual Report No. 3, July 11, 1960 through December 31, 1960. (Westinghouse Electric Corp. Electronic Tube Div., Baltimore). Jan. 1, 1961. Contract DA-36-039-SC85248. 78p.

The use of photoemission to convert a solar-photon flux into electrical power and the development of a high power-per-unit-weight photogenerator suitable for use in space are considered. Experimental results obtained with a movable-anode photogenerator are presented and show how efficiency depends on anode-to-photocathode spacing. Phototube experiments and production are reviewed, showing the necessity of clean tube components and the desirability of a small volume during cesiation. The design of a glass-tubing processing system is discussed, and the design of a photoemissive converter is given, showing the compatibility of the two. (auth)

17814 (ANL-6536) HIGH-TEMPERATURE KNUDSEN EFFUSION CELL ASSEMBLY. E. G. Rauh, R. C. Sadler, and R. J. Thorn (Argonne National Lab., Ill.). Apr. 1962. Contract W-31-109-eng-38. 5p.

A Knudsen effusion cell assembly is described which was designed for study of high-temperature vaporization processes with a time-of-flight mass spectrometer. The cell is heated by electron bombardment, and temperatures up to 3100°K were reached. (J.R.D.)

17815 (BNL-721) SOLAR CELL DOSIMETER. Report No. 1. A. Muller, F. Rizzo, and L. Galanter (Brookhaven National Lab., Upton, N. Y.). Feb. 1962. Contract [AT(30-1)-GEN-16]. 10p.

A series of preliminary experiments were carried out to evaluate the characteristics of a solar cell dosimeter. Theory, characteristics as a dose rate dosimeter, radiation damage, and temperature dependence are discussed. (M.C.G.)

17816 (EURAEC-107) SOLID STATE DETECTOR FOR NEUTRONS. Quarterly Report No. 2, January–March 1961. (Brussels. Centre d'Étude de l'Energie Nucléaire). Mar. 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract [029-60-10RDB]. 27p.

Activities are reported in a program to determine the effects of neutrons on SiC junctions for use as neutron barrier counters. Damage in reactor irradiation at 100 to 150°C of grown SiC diodes is described and radiation effects at 500°C in these diodes are summarized. Data from resistivity and Hall measurements are included. (J.R.D.)

17817 (HW-69879 (Rev.)) AN AREA RADIATION MONITOR WITH LOGARITHMIC AND LINEAR RANGES. W. G. Spear (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 22, 1962. Contract AT(45-1)-1350. 27p.

An area radiation monitor, which incorporates both logarithmic and multidecade linear ranges, was developed, and two experimental instruments have completed nine months of thorough evaluation and testing. One of the scintillation transistorized instruments had linear ranges of 0-10 mr/hr decaded to 0-10 r/hr and a logarithmic range from approximately 1 mr/hr to 10 r/hr. Other ranges, either more or less sensitive, can be easily incorporated by detector and/or calibration changes. In addition, the prototype circuitry was slightly modified for the design of a third instrument which employs a six decade logarithmic scale extending from approximately 1 mr/hr to 1000 r/hr with a single meter employing two scales each extending over the full meter face. The two prototypes, which incorporated both linear and logarithmic ranges, performed satisfactorily under test conditions involving line voltage variation, vibration, temperature variation, accuracy, drift, and detector aging. The instruments employ scintillation detectors, electromechanical choppers, transistorized amplifiers, meter readout, both low and high level adjustable alarming functions, and recorder driving capabilities. The detector can be more than 500 feet from the main instrument with inexpensive standard coaxial shielded cables used for information transfer. Calibration is not affected by the length of the interconnecting cables. (auth)

17818 (HW-70649) RUPTURE DETECTION INSTRUMENTATION FOR PRTR FUEL ELEMENT RUPTURE TEST FACILITY. N. T. Hildreth (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 29, 1961. Contract [AT(45-1)-1350]. 24p.

Instrumentation for the Plutonium Recycle Test Reactor Fuel Element Rupture Test Facility is described. This instrumentation allows studies on fuel rupture detection, fuel failure mechanisms, and reactor protection. The sampling system, flow control and recording, and detectors are described. (M.C.G.)

17819 (HW-71352) A RADIONUCLIDE CELL EXHAUST MONITORING SYSTEM. M. O. Rankin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 14, 1961. Contract [AT(45-1)-1350].

An alpha and beta cell exhaust monitor was developed to sample and monitor filtered exhaust gasses for particulate radionuclides. The system will alarm in less than 10 min if the stack exist air-borne concentrations of mixed fission product beta emitters exceed 6.2×10^{-15} C/cc or if alpha emitter concentrations exceed 1.2×10^{-17} C/cc. By using known sensitivity and alarm levels, and with knowledge of the flow rates, total stack emissions before alarm activation were calculated. These alarm-point total stack emissions are 1.8×10^{-4} c for mixed fission products and 5.6×10^{-7} c for alpha emitters. (auth)

17820 (KAPL-2067-2) TEMPERATURE MEASUREMENT THEORY. J. A. McCann (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 1, 1962. Contract W-31-109-Eng-52. 72p.

Thermocouples, thermocouple materials, and thermocouple application in non-isothermal conditions such as in nuclear reactors, irradiation tests, and loop tests are described. Data obtained from manufacturers and other open literature are presented. These data were applied to hypothetical measurement problems which show how to use thermocouples correctly in non-isothermal conditions. Thermocouple application problems are defined from various viewpoints such as that of mechanical and thermal designers, test engineers, and metallurgists. Applications to specific projects are given in the area of establishing allowable conditions for splicing thermocouples, the reaction of thermocouple materials with their environment, and the effects of mechanical installation tolerances on temperature measurement accuracies. (auth)

17821 (NRL-5646) ELECTRONIC EQUILIBRIUM IN FREE-AIR CHAMBERS AND A PROPOSED NEW CHAMBER DESIGN. Interim Report. F. H. Attix (Naval Research Lab., Washington, D. C.). May 18, 1961. 16p.

The concept of electronic equilibrium, particularly as applied to free-air chambers, has been frequently used to cover more than one idea. In order to separate and define clearly each idea, definitions are established for "integral charged-particle equilibrium" and "charged-particle compensation." In addition, a definition for "charged-particle equilibrium" is proposed along the lines set forth by Roesch. A new type of free-air ionization chamber is proposed in which electric-field uniformity plays no role in defining the ion-collecting volume. The chamber is based essentially upon a subtraction method in which two readings are taken of the ionization and the difference is used as a measure of exposure dose. The chamber is collapsible, its midplane being fixed with respect to the x ray source. The ionization in the two equal air volumes on either side of the midplane of the chamber when in a collapsed condition and the ionization of the two volumes defined by the chamber in an expanded condition are related in such a way that their difference is just the ionization in the extra volume of air created in the middle of the chamber by the expansion of the chamber. It is evident that the end planes of this extra volume of air are not defined by electrostatic lines of force, as is the case for conventional chambers. Consequently, the new chamber has no need for guard plates or other fieldshaping electrodes which are typical of conventional free-air chambers. Since the uncertainty about the degree of field uniformity represents the largest single source of error in conventional chambers, its elimination is a considerable advantage. (auth)

17822 (PPAD-450-E) SOME MEASUREMENTS FOR THE EFFICIENCY IN OBSERVING PHOTOELECTRONS IN IMAGE INTENSIFIERS. J. R. Waters, G. T. Reynolds, D. B. Scarl, and R. A. Zdanis (Princeton–Pennsylvania Accelerator, Princeton, N. J. and Princeton Univ., N. J.). Mar. 1, 1962. Contract AT(30-1)-2137. 17p.

Presented at 8th Scintillation and Semiconductor Counter Symposium, Washington, D. C., March 1-3, 1962.

A method is described for measuring the efficiency with which photoelectrons can be detected in an image intensifier system. A weak light is shone onto the first cathode and the photoelectron current measured. The light is then attenuated by a large known factor and compared with the number of spots observed in a given time. A simple system was used to demonstrate this method; a maximum efficiency of 85% was achieved. The results of experiments with a filament scintillation chamber and a Čerenkov detector using image intensifiers are discussed and yield some information about the electron detection efficiency. A simple method of finding the detection threshold is also mentioned with two typical examples of its results. (auth)

17823 (SCDR-54-62) TELEMETRY SIGNAL SIMULATOR. H. D. Sorensen (Sandia Corp. Livermore Lab., Livermore, Calif.). Apr. 1962. Contract [AT(29-1)-789]. 25p.

A telemetry signal simulator is used during ground checks of telemetry systems to simulate the signals the telemetry system will receive in flight. By using this simulator, the operator can make a pin-to-pin check of an entire telemetry system automatically. (auth)

17824 (SCTM-311-62-81) MEASUREMENT OF POWER SPECTRA FOR NONSTATIONARY RANDOM SIGNALS. P. T. Schoenemann (Sandia Corp., Albuquerque, N. Mex.). Apr. 1962. Contract AT(29-1)-789. 17p.

The use of standard techniques for measuring the power spectra of stationary phenomena in the treatment of nonstationary physical phenomena can lead to erroneous results. Some of the tools available for the analysis of nonstationary random phenomena are outlined and the applicability of these tools to some practical engineering problems is discussed. (auth)

17825 (TID-3907(Rev.I)) BIBLIOGRAPHY ON SEMICONDUCTOR NUCLEAR RADIATION DETECTORS. J. L. Blankenship (Oak Ridge National Lab., Tenn.) and Henry D. Raleigh (Division of Technical Information Extension, AEC), comps. Apr. 1962. 50p.

A bibliography on the theory, manufacture, properties, performance, and utilization of semiconductor materials for the detection of nuclear radiation is presented. The 464 references cover reports and published literature through January 1962. The report references are arranged alpha-numerically by report number behind the name of the issuing agency. The journal references are arranged alphabetically by journal title, and the conferences are arranged generally by date. An author index is included. (M.C.G.)

17826 (Y-1385) AUTOMATIC MASS SPECTROMETER FOR ISOTOPIC ANALYSIS OF LITHIUM. W. T. McBryde and E. F. Gammon (Union Carbide Nuclear Co. Y-12

Plant, Oak Ridge, Tenn.). Mar. 15, 1962. Contract W-7405-eng-26. 22p.

An automatic mass spectrometer was developed which can analyze microgram quantities of Li in five minutes or less. The isotopic abundances are automatically computed to at. % and wt % by an analog computer. The assay is displayed on a digital ratiometer and a digital printer records the results on a sample requisition in reportable form. (auth)

17827 (AEC-tr-5102) ANALYSIS OF SIMPLE AND COMPLEX GAMMA SPECTRA. Th. Schneider and H. Muenzel. Translated by A. Cornell from Atompraxis, 7: 412-19(Nov. 1961). 17p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 4339.

17828 (FTD-TT-61-102) ELECTRONIC DEVICES (SECOND EDITION). M. S. Kaufman and G. M. Yankin—V. I. Shamshur, ed. Translation of "Elektronnye Pribory" (a publication of the State Power Publishing House, Moscow, 1960). 653p.

The theory of operation, construction, and basic design of electronic and semiconductor devices, as well as the relationship between the parameters and designs of the devices and the most important circuits in which they are applied are given. The basic facts of electron theory and electron optics are considered. Electron emission, hot cathodes, diodes, triodes, triode applications, tetrodes and pentodes, tubes for frequency conversion, receiving-amplifier tubes, transmitting tubes, electron tubes for super-high frequencies, klystrons, magnetrons, traveling-wave and backward-wave tubes, photoelectric devices, cathode ray and electro-optical devices, x-ray tubes, and semiconductor devices are discussed. (auth)

17829 (JPRS-13233) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, MINISTRY OF HIGHER AND SPECIALIZED SECONDARY EDUCATION, RADIO ENGINEERING SERIES. Translation of Izvest. Vysshikh Ucheb. Zavedenii, Radiotekh., 4: No. 4, 369-511(1961). 166p.

Nineteen papers are presented; separate abstracts have been prepared for 2. The papers not abstracted separately deal with topics such as electronic equipment (particularly transistor circuits, microwave equipment, amplifiers and oscillators, and digital systems) and studies of 4-terminal equivalent circuits, noise, radio-wave fluctuations in turbulent media, surface-wave excitation, modulation and selectivity, and F-M signal distortion. Several discussions are presented of engineering curricula in the USSR. (T.F.H.)

17830 (JPRS-13233(p.90-7)) ION FOCUSSING FOR A FLAT ELECTRON BEAM. Yu. D. Zharkov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiotekh., 4: 446-52(1961).

Focusing of an electron beam by passing it through an ionized gas is discussed, with particular attention to the effects of thermal velocity distributions. Expressions are deduced for the amplitudes and wavelengths of surface fluctuations, which are assumed to be small. (T.F.H.)

17831 (JPRS-13233(p.145-8)) CALCULATION OF MAGNETIC FOCUSSING FOR AN ELECTRON BEAM IN A RETARDING ELECTROSTATIC FIELD. N. S. Zinchenko. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiotekh., 4: 496-8(1961).

A configuration is considered in which an electron beam is accelerated through an accelerating electrode and enters the field of a collector. The collector field is assumed to have a decelerating effect on the beam, and thus the space-charge variations along the beam tend to defocus the beam. Neglecting secondary emission and the presence of ions in the beam, it is found that focusing can be obtained for any given electrostatic potential if an axial magnetic field is applied that varies as $(1-\alpha z)^{1/2}$, where α is a constant and z is the axial distance. (T.F.H.)

17832 THE BALANCED ROSS FILTER CHOPPER AS DC-AC CONVERTER AND ITS USE IN X-RAY MEASUREMENTS. Erkki Laurila. Ann. Acad. Sci. Fennicae. Ser. A, VI, No. 90, 1-13(1962). (In English)

An ionization chamber system which acts as selective monochromator for x rays is described. The essential component of the system is a pair of balanced Ross filters which vibrate with a frequency of $\frac{1}{2}f_0$, when f_0 is the line voltage frequency and half-wave rectification is used. In the amplifier an electromechanical resonance filter with a high Q-value and very narrow band width is used. The lowest measurable ionization current at a signal-to-noise ratio of 3 is 4×10^{-16} amp. (auth)

17833 MEASUREMENT SENSITIVITY AND MARGIN OF ERROR IN MEASURING THICKNESS AND DENSITY WITH RADIOACTIVE SIOTOPES ACCORDING TO THE PENETRATION-BEAM METHOD. W. Dietzsch (VEB-Vakutronik, Dresden). Atompraxis, 8: 129-33(Apr. 1962). (In German)

17834 MEASUREMENT SENSITIVITY IN HOMOGENEOUSLY DISTRIBUTED ACTIVITIES. R. Plesch (Siemans and Halske A. G., Karlsruhe, Ger.). Atompraxis, 8: 135-40(Apr. 1962). (In German)

The German Radiation-Protection Regulations assign particular importance to direct measurement of activity in water and air without enriching the active substances. For this purpose a large-surface gas-flow counter with an extremely thin seal foil suitable for measuring beta radiation is used. This detector was used to derive an equation for the specific sensitivity of detectors in water and air to beta and gamma radiation. A comparison of this equation with the measurement results of a large-surface flow counter and a thin-walled Geiger counter showed a satisfactory agreement. For scintillation counters this equation gave values several times lower than the measurement values. Possible reasons for this are discussed. (auth)

17835 A HALL MAGNETOMETER. J. Jousselin. Atompraxis, 8: 140-4(Apr. 1962). (In French)

Probes with small dimensions, operating on the principle of the Hall effect, are preferred for measuring strongly varying magnetic fields. This principle is described together with the construction of a Hall magnetometer possessing a measurement range of 0 to 20000 gauss, subdivided into 5 stages. If the results are read off directly, the magnetometer is accurate to within 0.1% ± gauss; with use of a correction curve, it is accurate to within 0.01%. With a cable length of 2 m the device is completely temperature-compensated. A remarkable feature is a special switch system which makes it possible to attain this accuracy with an electric-supply tension-constant of only 1%. This means a considerable reduction in costs. (auth)

17836 A SIMPLE SINGLE-CHANNEL PULSE-HEIGHT ANALYZER WITH DEFLECTION TUBE. G. Brunner (Institut fur Angewandte Radioaktivität, Leipzig). Atompraxis, 8: 144-8(Apr. 1962). (In German)

A very simple electronic switching system for analyzing pulse-height distribution on the single-channel principle its basic component is a small standard-production electron tube, e.g., type E 80 T. (auth)

17837 GRAPHIC ASCERTAINMENT OF THE LIMIT OF DETERMINABILITY IN THE MEASUREMENT OF SLIGHT ACTIVITIES. K. Haberer (Technische Hochschule, Karlsruhe, Ger.). Atompraxis, 8: 148-51(Apr. 1962). (In German)

Formulas and graphs, based on the statistical criterion of Cowan and Nehemias, are presented for determining the lowest activity which can be demonstrated with a particular measurement system. Examples are given to illustrate the practical application of the diagram for determining this limit. (auth)

17838 ON THE CALIBRATION OF WHOLE BODY COUNTERS. R. M. Green and K. G. McNeill (Univ. of Toronto). Australian J. Appl. Sci., 13: 66-70(Mar. 1962).

Measurements were carried out to test the alpha approximation method and also to test the assumption that G_α is a constant for different body geometries at different energies. A group of six men, ranging from 120 to 210 lb in weight and from 5 ft to 6 ft 3 in. in height, each ingested the same quantity of Na^{22} (approximately 3 μC). After a minimum period of 18 hr to permit normal distribution throughout the body, a number of spectra were obtained for each man. Similar measurements were also made on a group of seven men, with variations in weight and height, who had ingested 3 μC of K^{42}. Despite the great variations in body geometry, for both energies the standard deviation from subject to subject was less than 2%. This tends to illustrate that the Cs/K ratio commonly measured in individuals will not depend on body geometry. It was also noted that α will very rarely be absorbed (the photoelectric cross section of tissue is small), and therefore will still have an opportunity of being detected by the crystal, though not of appearing in the photopeak of the full energy gamma ray. It is concluded that body burdens calculated by the alpha approximation method are correct to within the limits set by other factors. (P.C.H.)

17839 USE OF A 100-CHANNEL γ SPECTROMETER IN PROBLEMS OF NUCLEAR GEOLOGY. R. Coulomb and M. Goldsztein (Commissariat à l'Énergie Atomique, Fontenay-aux-Roses, France). Bull. soc. franç. mineral. et crist., 84: 13-19(1961). (CEA-1708). (In French)

A gamma spectrometry unit equipped with a 100-channel amplitude selector with magnetic memory is described. The various analytical methods adapted to geochemistry are discussed. (auth)

17840 SOME EXHIBITS AT THE ROYAL SOCIETY CONVERSAZIONE, MAY 1961. 4. A PROPANE-FILLED BUBBLE CHAMBER. J. McKenzie and M. R. Bowman (Clarendon Lab., Oxford). Contemporary Phys., 3: 130-3(Dec. 1961).

A propane-filled bubble chamber is described that has a volume of 1 liter. The operating pressure is 350 lb/in.^{2}. An expansion of 3% within about 10 msec is produced by coupling the piston to the flywheel of a small electric motor by a magnetic clutch. This operation requires a square-shaped current pulse of amplitude 4 amp lasting between 20 and 100 msec. When the clutch is energized, a synchronized flash illuminates tracks produced by the ionizing particles. (N.W.R.)

17841 OPTIMUM LINEAR FILTER FOR PULSE SHAPE RECOGNITION IN THE PRESENCE OF THERMAL NOISE. F. De Martini (Istituto di Fisica Sperimentale del Politecnico, Milan) and E. Gatti. Energia nucleare (Milan), 9: 160-3(Mar. 1962). (In English)

An optimum linear filter for discriminating maximum signal to noise ratio between two pulse-shapes was synthesized. This filter finds application for discrimination of pulses detected by a scintillation counter and due to particles of different specific ionizing power. These pulses are affected by Poisson noise correlated to the signals themselves and by uncorrelated noise due to thermoelectronic emission of the cathode of the multiplier phototube and to superposition of background radiation. The developed theory takes into account both types of noise and is a development of a precedent one in which only the correlated Poisson noise was considered. (auth)

17842 AN α-SPECTROMETER FOR NORMAL BIOLOGICAL LEVELS OF ACTIVITY. C. R. Hill (Inst. of Cancer Research, London). Health Phys., 8: 91-2(Feb. 1962).

The design and performance of an α spectrometer for the investigation of α activity at concentrations of the order of a picocurie per gram or less are given. The instrument consists essentially of a concentric pair of cylindrical electrodes, 90 cm long with radii of 30 and 0.45 cm, respectively. The unknown source is spread as a very thin film over the entire 15000 cm^2 inner surface of the outer electrode, and a standard calibration source can be exposed in a longitudinal notch cut from the outer electrode surface. Source materials are usually in the form of biological ashes of uncertain composition and solubility, but good-quality α sources can be prepared on a routine basis from such materials by very fine grinding followed by spraying, in the form of an aqueous suspension, on to the previously wetted backing sheet. With a good source, line widths of 110 kev have been achieved in the 4 to 6 Mev region, although values in the range 150 to 200 kev are normal. The effectiveness of the instrument is enhanced if it is used in conjunction with a sensitive total counter. (P.C.H.)

17843 CURRENT DEVELOPMENTS IN THE USE OF NITROUS OXIDE IN THE RADIATION DOSIMETRY ASSOCIATED WITH THE RADIATION EFFECTS REACTOR. R. E. Simpson (Naval Radiological Defense Lab., San Francisco). Health Phys., 8: 143-54(Mar.-Apr. 1962).

When exposed to a source of ionizing radiation of doses ranging from 10^6 to 10^{10} ergs/g carbon, nitrous oxide decomposes linearly as a function of the absorbed dose in the ratio $N_2 : O_2 : NO_2 :: 1.0 : 0.14 : 0.48$ as stable products. With the addition of a small amount of U^{235} to the dosimeter, the gas can be used in neutron dosimetry. The principle of Hartech and Dondes was utilized in the development of nitrous oxide in the dosimetry program associated with the Lockheed Radiation Effects Reactor (RER). This has included the design of practical dosimeters and vacuum analytical apparatus, equipment calibration, and the development of a routine method. Although the reactor exposure data produced a similar curve to that of the pure γ data, there are definite indications of the neutron effect in the decomposition values of the gas bias the γ dose. However, the expected break in the decomposition curve is obtained at the equivalent dose of 10^{11} ergs/g carbon. The advantages of nitrous oxide as a total-dose dosimeter include post-irradiation stability, flexibility, and economy. It is adaptable to a variety of uses, including high-flux material testing and total-dose monitoring in areas of high radiation exposure. (auth)

17844 THE USE OF A PROPORTIONAL COUNTER IN X-RAY STRUCTURE STUDIES. D. M. Kheiker, L. S. Zevin, I. E. Konstantinov, and V. A. Alekseev, (Moscow Engineering-Physics Inst.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 388-94(Mar. 1962). (In Russian)

The resolution of a proportional counter is better by a

factor of four than that of a scintillation counter, but the counting efficiency of a scintillation counter is 10 to 20% better than that of a proportional counter. The construction of a xenon-isopentane proportional counter with a 1 mm beryllium window on the side is described. It was found that the pulse amplitude was a linear function of energy for $\lambda_1 = 1.54$ Å and $\lambda_2 = 0.77$ Å. The gas amplification $H = Ce^{0.91V}$ (C = const) does not depend on the primary ionization. The resolution $ev = 2.36\sqrt{1.1/N}$, where N is the number of primary ion pairs formed by one quantum. For CuK_α(8.04 kev) radiation N = 358 ion pairs in xenon, and the resolution is 13.1%. An experimental resolution of 13% was obtained. Xenon is a more efficient adsorber of radiation than krypton or argon. The CuK_α peak can be completely resolved from the FeK_α peak. The CuK_α radiation can be separated from the CuK_β radiation, and the MoK_α from the MoK_β radiation, by using a thin filter. If the background radiation is "white" in nature, the proportional counter gives a better roentgenogram than a scintillation counter because of its superior resolution. (TTT)

17845 THE POISONING OF THORIATED TUNGSTEN CATHODES. R. O. Jenkins and W. G. Trodden (General Electric Co. Ltd., Wembley, Eng.). J. Electronics and Control (1), 12: 1-12(Jan. 1962). (In English)

An experimental study was made of the poisoning of the thermionic emission from thoriated tungsten cathodes by oxidizing gases. It is shown that rapid poisoning takes place when a critical partial pressure is exceeded. For a fully carburized cathode this critical partial pressure measured, using an omegatron mass spectrometer, is as follows: O_2 10^{-5} torr, CO_2 2.5×10^{-5} torr, and water vapor 6×10^{-4} torr. The total pressures measured by ion gage were considerably higher due to the formation of CO at the cathode surface. The resistance to poisoning depends almost entirely on the presence of carbon on the surface, and any decarburization lowers the critical pressure. For a truly uncarburized cathode the critical pressures are less than 10^{-9} torr, only the arrival of fresh thorium at the surface counteracting the adsorption of the poisoning gas. It appears probable that in the past so-called uncarburized cathodes must have had a small amount of carbon in the surface. (auth)

17846 THE WALL POTENTIAL IN LOW PRESSURE DIODE ION PUMPS. L. H. James and G. Carter (Univ. of Liverpool). J. Electronics and Control (1), 12: 63-9 (Jan. 1962). (In English)

The relationship between the wall potential in low pressure gas diodes and parameters such as the gas pressure and composition, electron current and energy, was investigated. The results are found to compare favorably with a simple theory based on current balance conditions at the wall. (auth)

17847 A HIGH EFFICIENCY 15 Mw, 400 Mc/s PULSED KLYSTRON. L. D. Clough, J. F. Dix, A. J. Monk, and P. Rowcroft (Services Electronics Research Lab., Harlow, Essex, Eng.). J. Electronics and Control (1), 12: 105-18 (Feb. 1962). (In English)

An experimental four-cavity pulsed klystron with a peak power output of 15 Mw at 400 Mc/s is described. The valve was designed for high efficiency and a figure of 61% was obtained at 30 db gain. The design procedure, method of testing, and the construction are described in detail. (auth)

17848 FREQUENCY RESPONSE OF SEMICIRCULAR MAGNETIC SPECTROSCOPE. Gunji Shinoda, Tatsuro Suzuki, and Susumu Kato (Osaka Univ.). J. Phys. Soc. Japan, 17: 691-7(Apr. 1962). (In English)

The performance of a semicircular magnetic spectrograph and spectrometer was studied using the Fourier analysis. The approximate expression for the intensity distribution of the image is given, and the spatial frequency response was calculated as in the field of lens optics. The applications of the theory are described for determination of the optimum condition of experiments, evaluation of the performance of spectroscope, estimation of the input spectrum through the output, and measuring intervals for discrete recording. The approach may be useful for the comparison of performance of different types of magnetic spectroscopes and may give the first step to introduce information theory into the problem of magnetic spectroscopy. (auth)

17849 A STUDY OF PERFECT FOCUSING MASS SPECTROMETER. Tatsuo Arikawa, Hajime Higaki, Sachiomi Kaneko, Giiti Iwata, and Goro Miyamoto (Tokyo Univ.). J. Phys. Soc. Japan, 17: 711-12(Apr. 1962). (In English)

A perfect focusing mass spectrometer was constructed and tested. A homogeneous magnetic field (0,0,H) was combined with an electric field given by the potential $k/2(-x^2 - y^2 + 2z^2)$. Charged particles at arbitrary velocities and from a point source may be focused at a single point that depends only on the effective mass-to-charge ratio of the particles. Tests using electrons are described. (L.N.N.)

17850 ARGON ACTIVATION FOR NEUTRON-FLUX MEASUREMENT. Charles R. F. Smith (Atomic International, Canoga Park, Calif.). Nucleonics, 20: No. 5, 6-7; 104(May 1962).

A neutron-flux monitoring system using argon activation is described. The system tested in KEWB is composed of scintillator, ion chamber, and G-M tube. The system is not subject to sensitivity loss due to argon burnup since the argon is continually replaced, and the sensitivity is not affected by radiation damage to electrical insulation because no electrical circuitry is in the core. The system is sensitive to changes in temperature as well as in neutron flux. Results are presented of measurements made in the KEWB and L-77 water-boiler neutron source along with the parameters of the flux-monitoring systems. The system's performance improves as reactor power is increased. The signal is linear with reactor power over a three decade range. (N.W.R.)

17851 SEMICONDUCTORS, SCINTILLATORS AND PULSE-HEIGHT ANALYZERS. D. Allan Bromley (Yale Univ., New Haven), James W. Mayer, Robert L. Chase, Russell L. Heath, Thomas K. Alexander, and Lloyd B. Robinson. Nucleonics, 20: No. 5, 53-74(May 1962).

Development, theory, design, characteristics, performance, and uses of semiconductors, scintillators, and pulse-height analyzers as particle detectors are described. The information is obtained from papers presented at the Eighth Scintillation and Semiconductor Counter Symposium held in March, 1962. (N.W.R.)

17852 INFLUENCE OF SCANNING SPEED ON THE EFFICIENCY OF VISUAL DETECTION METHODS. E. Marquit (Univ. of Warsaw). Nuovo cimento (10), 23: 781-3(Feb. 16, 1962). (In English)

Experiments in which the events do not constitute a homogeneous group are considered. Even for events corresponding to an interval of physical parameters, individual events can have different degrees of difficulty of detection, depending on the local background in parts of the scanned area and on fluctuations in the characteristics by which the event is identified. The importance of choosing a scanning

speed affording an efficiency close to that theoretically obtainable using a given experimental technique is discussed. Problems arising in determining such a speed are considered. Differences in numbers of events found in trial scannnings for different t indicate relative efficiencies; true scanning efficiency cannot be determined merely from the increase in events detected as the scanning time per field is increased. (L.N.N.)

17853 AN ELECTRON SCINTILLATION SPECTROMETRY METHOD. Philip Blum (Sloan-Kettering Inst. for Cancer Research, New York). Radiation Research, 16: 626-45 (May 1962).

An anthracene scintillation spectrometer provides a tool for determining by direct experimental means the energy distributions of the electrons initially set in motion in tissue by γ-rays. However, a serious distortion exists in the spectra thus obtained, owing to crystal boundary effects, the experimental data indicating more low-energy electrons and fewer high-energy electrons than actually exist. This distortion is most pronounced when electron energy is high and when crystal size is small, as is required when spectra must be specified as a function of location. This boundary distortion was investigated for initial electron spectra produced in water by Co^{60} γ-rays and was found to be appreciable even for anthracene crystals that were much larger than desired for localizing such spectra precisely. As a solution to this problem, an experimental correction method has been devised and investigated, both analytically and experimentally. This method should be applicable to a wide variety of γ-ray sources and source geometries. It consists in subtracting the spectra of two crystals of different thickness to obtain the spectrum of the thin difference volume. The resulting spectrum, thus localized, is free of the distortion of all but a small portion of crystal bounding surfaces. The applicability of the correction method is illustrated by the determination of the initial electron spectra produced at 2 cm and 5 cm from a point source of Co^{60} in an infinite water medium. These spectral determinations were obtained with a localization of better than ±2 mm. (auth)

17854 RADIOMETRIC STANDARDS AND MEASUREMENTS. Notes on Applied Science No. 23. E. J. Gillham. London, Her Majesty's Stationery Office, 1961. 27p. 1s.9d.

Descriptions are given of methods used to measure monochromatic and total radiation and for the absolute measurement of radiation. Discussion on the measurement of total radiation includes the Moll thermopile, intercomparison of thermopiles, radiation exchange, selectivity of thermopiles for total radiation, and measurement of radiant power. Included in the measurement of monochromatic radiation are relative spectral measurements, absolute measurement of monochromatic radiation, and measurement of spectral selectivity of thermopiles. For absolute measurement, principles of measurement and the Guild drift radiometer are discussed. (P.C.H.)

17855 APPARATUS FOR MEASURING THE RADIOACTIVITY OF PARTICLES IN A GAS. Jacob Hendrik Spaa and Edward Fokko de Haan (to North American Philips Co., Inc.). U. S. Patent 3,015,729. Jan. 2, 1962.

A Geiger-Mueller counter is designed for detecting radioactive particles in a gas. The counter is provided with a hollow anode through which the gas to be examined is passed and in which the means for the electrostatic deposition of the particles is mounted. Since the counting space entirely encloses the precipitated particles, the counting efficiency is high. (D.L.C.)

17856 MEASUREMENT OF RADIOACTIVITY EMITTING COMPOUNDS. Jean-Claude Roucayrol, Erich Oberhausen, and Richard Schussler (to Centre National de la Recherche Scientifique). U. S. Patent 3,017,510. Jan. 16, 1962.

An apparatus is designed for continuous measurement of radioactive materials supported on a porous strip such as is used in paper chromatography. The apparatus includes a photomultiplier device mounted in a housing with an orifice formed above the photomultiplier. In operation, the strip is moved across the orifice, and liquid scintillator is applied to the strip from a capillary tube, enabling the radioactivity in the strip to be detected. Thus, part of the beta and alpha rays, which normally would be absorbed in the strip, are detected. (D.L.C.)

17857 METHODS OF AND APPARATUS FOR MEASURING COATING AMOUNTS. Don H. Johns (to American Can Co.). U. S. Patent 3,019,336. Jan. 30, 1962.

A method and apparatus are described for measuring the thickness of a wet organic coating at the time of its application to a metal sheet. The method is based on backscattered beta radiation. (D.L.C.)

17858 WELL LOGGING BY SELECTIVE DETECTION OF NEUTRONS BY RESONANT CAPTURE. Robert E. Fearon and Jean M. Thayer (to Well Surveys, Inc.). U. S. Patent 3,019,337. Jan. 30, 1962.

A neutron-neutron well logging instrument is designed for detecting petroleum in subsurface strata adjacent to a bore hole. The instrument includes a monoenergetic neutron source and an impulse ionization chamber for measuring the intensity of neutrons in specific energy bands which were reflected from the formation in the bore hole. (D.L.C.)

17859 THICKNESS DETECTOR FOR COAL MINING MACHINE. Ralph Monaghan, Billy F. Wilson, and Guenther Knapp (to Well Surveys, Inc.). U. S. Patent 3,019,338. Jan. 30, 1962.

A device is designed for measuring the thickness of the coal above and below the portion being mined. The device, mounted on a coal mining machine, irradiates the coal with gamma rays and measures the amount scattered back. Thus, the device makes it possible to mine to the optimum coal thickness without slippage of the machine on fire clay or cave-in. (D.L.C.)

17860 RADIAC ALARM DOSIMETER. Edward J. Wesley (to Dept. of the Navy). U. S. Patent 3,019,339. Jan. 30, 1962

A circuit is given for a single recycling dosimeter which gives both dose and dose rate information in a contaminated area. The circuit comprises means for responding to a radiation field, a blocking oscillator with a transistor as an active element for receiving the response, and a plurality of transformer-coupled feedback circuits interposed between the responding means and the receiving means, whereby a uniform pulse of large amplitude is generated by the receiving means. The circuit has a high-impedance output, and a mechanical register and alarm circuit are connected to the output. (D.L.C.)

17861 TRACER LOGGING BY NEUTRON ACTIVATION. Ralph Monaghan (to Well Surveys, Inc.). U. S. Patent 3,019,341. Jan. 20, 1962.

A novel method and apparatus are described for tracer studies of porous subsurface strata with well logging instruments. In this method, a normally non-radioactive tracer which becomes activated when irradiated with neutrons is injected into a well, and after an interval, a

neutron-gamma logging instrument with means for turning off the neutron source is introduced into the well to detect and measure the tracer. (D.L.C.)

17862 TEMPERATURE MEASURING APPARATUS FOR FUEL ELEMENTS OF NUCLEAR REACTORS. Charles Herbert Quinton Fifield, Derek Randall Smith, and John Albert Robinson (to AEI-John Thompson Nuclear Energy Co. Ltd.). U. S. Patent 3,021,274. Feb. 13, 1962.

A thermocouple arrangement is designed for temperature measurement at the fuel elements mounted in carriers located in a graphite moderator such as in gas-cooled reactors. In the arrangement, a thermocouple is inserted in the metal canning of a fuel element, and electrical leads are established between the thermocouple and a spring-pressed contact plunger extending laterally outward from the carrier. Ceramic blocks between the moderator blocks forming the fuel channels are provided with contact strips over which the plungers slide. (D.L.C.)

17863 METHOD FOR PRODUCING RADIATION SENSITIVE ALKALI HALIDE CRYSTALS. Howard W. Etzel and David A. Patterson. U. S. Patent 3,021,286. Feb. 13, 1962.

A method is given for producing alkali halide crystals that undergo permanent coloration when exposed to radiation and subsequent heating. The method comprises growing ingots of alkali halides containing small amounts of hydroxyl ions, baking the crystals in the vapor of an alkali metal, and cooling the crystals slowly to prevent formation of F centers. The hydroxyl ions may be added simply by growing the crystals with the Kyropoulos process in the presence of moist air, or by adding some alkali hydroxide to the melt, and the concentration of hydroxyl ion suitable for this method is 10 to 100 ppm. The resulting crystals are sensitized to ionizing radiation of ≥ 6 ev, whereby F centers are formed in the crystal and a permanent color is produced upon heating to $\geq 300°C$. (D.L.C.)

17864 LIGHT WATER ANALYSER. John G. Bayly and William H. Stevens (to Atomic Energy of Canada Ltd., Ottawa). U. S. Patent 3,021,427. Feb. 13, 1962.

A monitoring system for indicating the heavy water content of air is designed which is fast and simple. In the system, water vapor is condensed from the air and its heavy water is estimated from its infrared absorption in the neighborhood of $\lambda = 4\mu$. A compressor is provided for increasing the vapor pressure in the air to prevent frost formation due to very low humidity, and means is provided for separating bubbles from the condensate. (D.L.C.)

17865 NUCLEAR MAGNETIC RESONANCE MEASURING SYSTEM. Anthony D. Cennamo (to Industrial Nucleonics Corp.). U. S. Patent 3,021,475. Feb. 13, 1962.

A nuclear magnetic resonance apparatus is designed for measurements on elongated materials and is particularly useful for monitoring the moisture content of moving cord or thread. The apparatus differs from conventional arrangements in that the cord or thread wound on a spool is subjected to a steady magnetizing field from a surrounding solenoid coil before it is unwound and entered into the r-f coil for measurements. The purpose of this modification is to satisfy relaxation time requirements. (D.L.C.)

17866 PULSE INTEGRATING CIRCUIT WITH SERIALLY CONNECTED FEED AND RESERVOIR CAPACITORS. Edmund Harry Cooke-Yarborough (to United Kingdom Atomic Energy Authority). U. S. Patent 3,021,485. Feb. 13, 1962.

A pulse integrating circuit is designed with small diode leakage for improved performance. The circuit comprises a feed condenser and a reservoir condenser which are charged in series through the control grid/cathode path of the first valve of a d-c amplifier during the pulses. The feed condenser is discharged after each pulse, and the reservoir condenser forms a negative feedback connection for the amplifier between pulses, whereby the reservoir condenser receives a constant charge increment during each pulse and the output voltage of the amplifier is the voltage across the reservoir condenser. (D.L.C.)

17867 SAFETY DEVICE FOR THE METHOD OF PROTECTING NUCLEAR POWER PLANTS. Alf Kolflat. U. S. Patent 3,022,238. Feb. 20, 1962.

A safety device is described for preventing a pressure rise within a reactor containment vessel due to reactor rupture. The device comprises tiers of water-filled trays arranged around the reactor so that heat released by a reactor accident is absorbed immediately. A sprinkler system may also be provided in the upper part of the vessel for reducing pressure should it rise above atmospheric. (D.L.C.)

17868 RADIATION DOSIMETER. Nicholas Anton. U. S. Patent 3,022,424. Feb. 20, 1962.

Two detectors are designed for applications as direct-reading dosimeters over a wide range of energies. Both are based on the use of combinations of absorbers and shields to obtain a radiation response which follows a predetermined law of variation. The first detector is a self-quenching Geiger counter tube with the chamber wall made of iron and additional metals, and the response approximates the absorption-energy curve for air. The second detector is a pressurized ionization chamber with a wall of different materials for obtaining a predetermined response law and a novel electrode system for responding to both beta and gamma rays. (D.L.C.)

17869 CONTINUOUS READING FREE NUCLEAR PRECESSION MAGNETOMETER AND METHOD. Paul M. Moser (to Dept. of the Navy). U. S. Patent 3,024,410. Mar. 6, 1962.

A magnetometer of the free nuclear precession type is designed which will function at any orientation with respect to the field being measured and which avoids the drawbacks of a pulsed polarizing field. In the magnetometer, a liquid containing nuclei of large gyromagnetic ratio is passed successively through a constant strong polarizing magnetic field and a detection coil immersed in the field being measured, and the voltage induced in the coil is amplified and its frequency measured. The magnetometer is especially applicable to measurements of weak magnetic fields, e.g., earth's magnetic field, since frequency measurements may be made over as long a period as is required. (D.L.C.)

17870 HOMOGENEITY MEASUREMENT. Warner W. Schultz (General Electric Co.). U. S. Patent 3,025,400. Mar. 13, 1962.

A nondestructive test method is given for detecting and locating inhomogeneities in a metallic alloy. In this method, the sample to be tested is irradiated with neutrons in such a way that the elements of the sample are symmetrically activated about some arbitrary axis of the sample and the radiation intensity from a path equidistant from the axis is proportional to the content of the activated elements along the path. A device for symmetrical activation and detection is described. (D.L.C.)

17871 RADIATION DETECTOR PROBES. Edward J. Betzold, Jr. and Jack H. Crow (to Nuclear Corp. of America, Inc.). U. S. Patent 3,025,404. Mar. 13, 1962.

A light-weight, portable scintillation detector probe is designed which may be connected to a measuring and recording instrument by only a single coaxial cable. The probe includes a scintillation crystal, a photomultiplier tube, and a transistorized signal pre-amplifier. (D.L.C.)

17872 RADIATION CALORIMETER-DOSIMETER. Ben Petree (to Dept. of Commerce). U. S. Patent 3,033,985. May 8, 1962.

A calorimetric radiation dosimeter is designed which is simple and accurate. The dosimeter comprises a core of electrically and thermally conducting material, e.g., graphite, a thermal shield of the same material and enclosing the core, means for sensing the temperature change in the core when subjected to irradiation, and means for adjusting the temperature of the shield so that it is the same as that of the core. The calorimeter is calibrated by measuring the amount of electrical power necessary for a certain core temperature rise. (D.L.C.)

17873 CHROMATOGRAPHIC METHOD AND APPARATUS. Eric B. Fowler and Wayne A. Rhinehart (to Iowa State Coll. Research Foundation, Inc.). U. S. Patent 3,033,986. May 8, 1962.

An automatic scanning and recording apparatus is designed for scanning a chromatographic strip for radioactivity. The apparatus comprises a sealable chamber, scanning means within the chamber, a drum for carrying a spirally wound chromatographic strip, means for moving the drum to align successive portions of the strip with the scanner, detection means, and means for evacuating the chamber and for introducing counting gas into the evacuated chamber. (D.L.C.)

17874 RADIATION-RESPONSIVE APPARATUS. Sidney Soloway (Schlumberger Well Surveying Corp.). U. S. Patent 3,034,008. May 8, 1962.

A radiation-responsive apparatus for detecting high-energy neutrons is designed for keeping the neutron output constant in a neutron-gamma well logging instrument. The detector comprises a chamber lined with zirconium hydride and forming one electrode, and a wire electrode within the chamber, the chamber being filled with argon at a pressure of 0.2 to several atmospheres. The detector is disposed within the logging instrument near the d-t neutron generator; in operation, a fraction of the resulting 14-Mev neutrons reaches the detector and produces recoil protons in the hydride layer with consequent ionization of the argon. The pulses thus generated are amplified and integrated to develop a control potential which is supplied to a voltage control circuit to maintain the neutron output constant. One advantage of the detector over previous ones is that it is insensitive to temperature. Several embodiments of the detector are described. (D.L.C.)

17875 DEVICE FOR ASCERTAINING NUCLEAR INDUCTION SPECTRA. Hans Heinrich Guenthard and Johann Jaroslav Primas (Trüb, Taüber and Co.). U. S. Patent 3,034,039. May 8, 1962.

A device for measuring the nuclear magnetic resonance spectra of nuclei is designed for improved resolution. The device comprises means for producing a direct magnetic field, a test specimen head in the direct magnetic field, at least four transmitter coils of D_{2h} symmetry in the head, electrical means connected to the transmitter coils to generate two magnetic circuits of mirror symmetry to one another, a receiver coil mounted within the direct magnetic field and alternating magnetic fields, and means for measuring the voltage induced in the receiver coil. The device includes a voltage leakage compensation bridge. (D.L.C.)

17876 NUCLEAR MAGNETIC RESONANCE SPECTROMETER. Rollie B. Williams (to Esso Research and Engineering Co.). U. S. Patent 3,034,040. May 8, 1962.

A nuclear magnetic resonance spectrometer is designed with a control probe for keeping the magnetic field constant. The control probe has two magnetic field change detecting and correcting circuits, one for correcting short-term changes and the other for long-term changes. Thus, very slow scan rates may be used with the spectrometer for high resolution. (D.L.C.)

17877 RADIATION COUNTER. Clyde L. Cowan, Jr. U. S. Patent 3,035,172. May 15, 1962.

A liquid scintillation counter is designed for commercial and industrial application. The scintillator liquid is contained within a casing, which is coated on its outside with a white material for optimum light reflection. The casing may be sectionalized for particular application, e.g., discrimination of Co^{60} gamma radiation from background, and may be in the form of a toroidal chamber, with fluid to be counted flowing through the inner passageway. An embodiment of the counter is described for analysis of oil well borings. (D.L.C.)

17878 NEUTRON DETECTORS. Lydie Koch and Jacques Labeyrie (to Commissariat à l'Énergie Atomique). U. S. Patent 3,035,173. May 15, 1962.

A simple neutron detector is designed for detecting a neutron flux in the presence of an intensive gamma flux. In the detector, the neutron flux is made to impinge on a target of fissionable material in a chamber, and the resulting fission products are swept out of the chamber by a gas stream to a detector some distance away from the neutron and gamma flux. The gas must be one relatively little activated by neutrons, and the detector may be of any suitable type. (D.L.C.)

Materials Testing

17879 FLAW DETECTION. Victor V. Verbinski (to General Electric Co.). U. S. Patent 3,025,399. Mar. 13, 1962.

A nondestructive test method is given for determining the location and depth of inhomogeneous inclusions of an element in a mixture, e.g., an alloy. The method is identical with that described in U. S. Patent 3,025,400 in that the sample is irradiated with neutrons so that it is symmetrically activated about some arbitrary axis. However, the method goes further in that, once an inhomogeneity has been located, its depth is determined by noting the change in the relative proportions of the individual gamma radiations emitted by the activated element in the inhomogeneity. (D.L.C.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

17880 (A/AC.82/G/L.760) A FALLOUT MODEL. II. SOME QUANTITATIVE PROPERTIES. J. Prawitz (Sweden. Försvarets Forskningsanstalt, Stockholm). Dec. 1961. 42p.

The concentration in the air and the accumulation on the ground of small particles after an instantaneous injection in the upper air were calculated for the case of particles with a density of 5 g/cm^3 and with sizes up to 0.005 mm. Equations and values of parameters are presented in detail. (auth)

17881 (MITS-47) THE ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS. A Semi-Annual Progress Report for the Six-Month Period Ending October 31, 1961. (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Contract AT(30-1)-956. 52p. (NYO-9201)

Progress is reported on research studies of: mixed adsorption from the gaseous phase on iron oxide; absorption of hematite–water–diisobutyl ketone systems; preparation and properties of crystals and sodium salts of hexadecyl sulfonic acid; inorganic ion absorption on ferric oxides; dissolution of zinc sulfides in sulfuric acid solutions; hysteresis of contact angles between solid, liquid, and gaseous ternary systems; rheology of unstable industrial suspensions; particle-size measurements by centrifugation; and radioisotope uses in analysis of coarse ore concentrations. (B.O.G.)

17882 (RME-4516) RECONNAISSANCE FOR URANIUM IN THE PROVINCES OF AYABACA AND HUANCABAMBA, DEPARTMENT OF PIURA, PERU. Lawrence J. Brown and Guillermo Morales S. (Division of Raw Materials, AEC and Peru. Junta de Control de Energia Atomica, Lima). Sept. 1957. 12p.

In 1957 a radiometric examination of rock outcrops in the Ayabaca and Huancabamba areas of northwestern Peru was made in conjunction with a geologic search for structures favorable for the occurrence of uranium minerals. No anomalous radioactivity was detected, and the geologic setting is believed to be generally unfavorable for uranium mineralization. (auth)

17883 (RME-4523) RECONNAISSANCE FOR URANIUM IN THE AYACUCHO BASIN, DEPARTMENTS OF HUANCAVELICA AND AYACUCHO, PERU. Justin B. Moses (Division of Raw Materials, AEC and Peru. Junta de Control de Energia Atomica, Lima). July 1957. 9p.

In 1957 a geologic and radiometric reconnaissance was made in the Ayacucho basin of southern Peru. This basin, an arm of a late Tertiary-Quaternary volcanic field, is bounded by Triassic-Jurassic rocks on the west and by Permian rocks on the east. Fragmental volcanics are the dominant rock types in the southern and central parts of the basin; flow rocks include andesite, rhyolite and possibly trachyte. Sandstones, conglomerates, and calcareous sedimentary rocks are found in the northern part. No anomalous radioactivity was observed in this investigation, and the geological environment apparently was not favorable for the deposition of uranium. (auth)

17884 (AEC-tr-5101) ISOTOPES OF URANIUM IN NATURAL CONDITIONS. II. ISOTOPIC COMPOSITION OF URANIUM OF MINERALS. V. V. Cherdyntsev, D. P. Orlov, E. A. Isabaev, and V. I. Ivanov. Translated by Lydia Venters (Argonne National Lab., Ill.) from Geokhimiya, No. 10, 840-8(1961). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 2030.

17885 RADIOACTIVITY OF DRY PARTICULATE MATTER IN AN URBAN ATMOSPHERE. John Rosinski and John Stockham (Illinois Inst. of Tech., Chicago). Bull. Am. Meteorol. Soc., 42: 688-92(Oct. 1961).

Total beta activity of dry atmospheric particles collected in Chicago, Illinois, ranged from 8973 pC per 100000 ft^3 of air in December 1958 to 177 pC per 100000 ft^3 in November 1959. From July to November 1959 the total beta activity decreased from 6990 to 399 pC per g of particles, and the strontium-90 activity from 229 to 16 pC per g. The activity of 1- to 10-micron particles was related to the cube of the particle diameter in the summer and to the fourth power in the winter. It is postulated that the activity resulted from rainsoaking during the particles' residence on the earth's surface. It was found that nonradioactive particles produced by urban activity dilute various size fractions of radioactive debris to different degrees. (auth)

17886 APPARATUS USING RADIOACTIVE PROBES FOR MEASURING THE VERTICAL COMPONENT OF ATMOSPHERIC POTENTIAL GRADIENT FROM AN AIRPLANE. Bernard Vonnegut and Charles B. Moore (Arthur D. Little, Inc., Cambridge, Mass.). Bull. Am. Meteorol. Soc., 42: 773-7(Nov. 1961).

An apparatus for measuring and recording the atmospheric potential gradient from an aircraft is described. It consists of two radioactive probes connected through an electromechanical coupling device to a conventional electrometer and recorder. (auth)

17887 PHYSICS APPLIED TO ARCHAEOLOGY. PART I. M. J. Aitken (Oxford Univ.). Contemporary Phys., 3: 161-76(Feb. 1962).

Methods of age determination and chemical analysis using physical techniques are discussed. Techniques and limitations of determination from C^{14} content and thermoluminescent dating are presented. Neutron activation analysis and optical emission spectroscopy are described. Geological and bone dating and x-ray fluorescent analysis are discussed. (L.N.N.)

17888 TRANSPORTATION AND PRECIPITATION OF URANIUM AND VANADIUM AT LOW TEMPERATURES, WITH SPECIAL REFERENCE TO SANDSTONE-TYPE URANIUM DEPOSITS. P. B. Hostetler and R. M. Garrels (U. S. Geological Survey, Denver and Harvard Univ., Cambridge, Mass.). Econ. Geol., 57: 137-61(Mar.-Apr. 1962).

Uranium and vanadium in sandstone-type deposits of the western United States apparently were transported to their present environment from external sources by low-temperature aqueous solutions. An attempt was made to interpret the characteristics of aqueous solutions capable of transporting significant quantities of uranium and vanadium through continental sedimentary rocks, and the changes in these characteristics that might result in precipitation of uraninite and other ore minerals in concentrations of ore grade. On the basis of present knowledge, the transportation environment is shown to be that of weakly alkaline, moderately reducing ground water, with an average or larger than average concentration of dissolved carbonate species ($H_2CO_3 + HCO_3^- + CO_3^{2-}$). Precipitation is induced by reduction, probably by carbonaceous material or hydrogen sulfide, or both. Uranium is transported mainly in the form of the highly stable uranyl dicarbon-

ate and tricarbonate complexes. Precipitation results from reduction of hexavalent aqueous uranium species to form uraninite, reduction of tetravalent vanadium to form montroseite, and fixation of uranyl ions by combination with potassium ions and quinquivalent vanadium to form the mineral carnotite. (auth)

17889 ALLANITE PEGMATITES, RED ROCK, NEVADA COMPARED WITH ALLANITE PEGMATITES IN SOUTHERN NEVADA AND CALIFORNIA. A. Volbroth (Univ. of Nevada, Reno). Econ. Geol., 57: 209-16(Mar.-Apr. 1962).

Small irregularly shaped aplitic allanite pegmatite bodies occurring near the contacts of a larger aplitic body with granodiorite are described. Allanite represents a considerable part of the pegmatite, is equally distributed, and can be regarded as a major constituent. Similar allanite pegmatites recently discovered in the Precambrian gneisses and schists in Clark County, Nevada and San Bernardino County, California are also described. Typical characteristics of allanite pegmatites in general are given. In view of the abundance of the Precambrian rare earth deposits, it is suggested that this Precambrian area may represent a characteristic rare earth province. (auth)

17890 SULFUR ISOTOPE DISTRIBUTION IN SULFIDES AND SULFATES FROM BROKEN HILL SOUTH, NEW SOUTH WALES. L. J. Lawrence and T. A. Rafter (Univ. of New South Wales, Kensington, Australia and Inst. of Nuclear Sciences, Lower Hutt, N. Z.). Econ. Geol., 57: 217-25(Mar.-Apr. 1962).

Sphalerite and galena are the dominant primary ore minerals found in the Broken Hill orebody of western New South Wales and both occur in minor amounts as supergene sulfides, especially at Broken Hill South. Isotope values for the primary sulfides $\delta S34$ range from 0 to +1.7. Secondary sulfates of the same metals (anglesite and goslarite) follow these figures very closely. The sphalerite and galena of supergene origin are among the highest $\delta S34$ values yet recorded averaging −43.3 and reaching −51.9. This is considered due to near optimum conditions of freedom of circulation of the downward moving ground waters and thus to maximum availability of the two sulfur isotopes. (auth)

17891 DIFFUSION FEATURES OF URANIUM–VANADIUM DEPOSITS IN MONTEZUMA CANYON, UTAH. Lyman C. Huff (U. S. Geological Survey, Denver) and Frank G. Lesure. Econ. Geol., 57: 226-37(Mar.-Apr. 1962).

Uranium–vanadium deposits in the Salt Wash Member of the Morrison Formation in Montezuma Canyon, San Juan County, Utah, exhibit zoning that is interpreted as a result of metal transport by diffusion. The concentric zones consist of a brown nonmineralized core, an olive-gray mineralized shell, and a gray nonmineralized outer zone. The brown zone is iron-stained, porous sandstone commonly containing abundant carbonaceous material. The curved mineralized layer completely encloses the brown zone, and is composed of oxidized uranium–vanadium minerals that impregnate sandstone. The gray zone is light-gray sandstone tightly cemented with calcite and commonly freckled with limonitic specks. The concentration of organic material in the brown zone suggests that this zone was once saturated with a reducing solution containing soluble organic compounds like alcohols and aldehydes derived from the organic material. The gray zone, on the other hand, was probably saturated with an oxidizing solution containing uranium and vanadium. Where these two solutions were in contact, oxidation-reduction reactions took place that caused the precipitation of low-valent uranium and vanadium minerals. The ellipsoidal shape of the ore layer and the lack of any exit or entrance for flowing solutions indicates that the dissolved metals moved through the gray zone by diffusion and were precipitated at the periphery of the reducing zone. Recent weathering and oxidation have altered the primary low-valent minerals to high-valent forms without noticeable leaching of the ore metals. (auth)

17892 METEORITIC KRYPTON AND BARIUM VERSUS THE GENERAL ISOTOPIC ANOMALIES IN METEORITIC XENON. D. Krummenacher, C. M. Merrihue, R. O. Pepin, and J. H. Reynolds (Univ. of California, Berkeley). Geochim. et Cosmochim. Acta, 26: 231-49(Feb. 1962). (In English)

General isotopic anomalies in meteoritic xenon are described in detail. Where superior isotopic analyses exist, the xenon anomalies appear to be the same for all meteorites. In other cases there is fair evidence that the xenon examined is a mixture of meteoritic and contaminating atmospheric xenon. Two superior krypton analyses for carbonaceous chondrites show no anomalies which are significant in comparison with those for xenon. Barium from the Richardton chondrite is of normal isotopic composition. Cyclotron deuterons produce no Xe^{124} in a tellurium target, although the other xenon isotopes, which are in excess in meteorites, are produced. A number of possible mechanisms for producing the general anomalies are discussed and found wanting. One of them calls for excess terrestrial fission xenon and for transfer of solar xenon to the atmosphere. It thus involves reasonable processes, but, as is shown, requires unreasonable yields for spontaneous fission. A mechanism that calls for excess meteoritic fission xenon and for gross mass fractionation of terrestrial xenon is proposed. It thus produces the observed anomalies accurately, but by somewhat unlikely processes. (auth)

17893 ON THE RETENTION OF PRIMORDIAL NOBLE GASES IN THE PESYANOE METEORITE. E. R. DuFresne and Edward Anders (Univ. of Chicago). Geochim. et Cosmochim. Acta, 26: 251-62(Feb. 1962). (In English)

A sample of the Pesyanoe meteorite was examined by x-ray diffraction microtechnique, in an effort to find minerals of known gas-trapping tendency and thus explain the high helium content of the meteorite. Determinations of enstatite, feldspar, and troilite were confirmed. The existence of many variant minor pyroxene phases, including clinopyroxene and rhombic pyroxene with stacking faults, shows that the history of the meteorite must have involved several complex heating and cooling cycles. In addition, there exists a variety of sulfides, which includes not only both magnetic and non-magnetic troilites, daubréelite, and oldhamite, but also a new mineral, MgS, the composition of which was checked by spectrographic analysis. All the sulfides present show a high degree of crystal imperfection. Vaterite (μ-$CaCO_3$) was found, but it is not known whether it is of terrestrial or antecedent origin. The high concentration of dislocations in the sulfides indicates a comparable abundance of other lattice defects. It is suggested that lattice defects of various kinds are the most probable loci of the gas atoms. The gases apparently entered the sulfide crystals during their growth, either in a closed magma chamber or in a hot gas stream containing both noble gases and sulfur compounds. Some circumstantial evidence favors the latter alternative. (auth)

17894 THE OCCURRENCE AND SIGNIFICANCE OF LEAD ISOTOPES IN PELAGIC SEDIMENTS. Tsaihwa J.

Chow and C. C. Patterson (California Inst. of Tech., Pasadena). Geochim. et Cosmochim. Acta, 26: 263-308(Feb. 1962). (In English)

Leads representing a major portion of the continental surface of the earth were sampled in pelagic sediments and isotopically analyzed. About two-thirds of the lead in all Pleistocene pelagic sediments were chemically precipitated from lead dissolved in sea water. The remaining one-third was transported as a constituent of solid particles. The rate of chemical deposition of lead tends to be uniform everywhere, while the rate of mechanical deposition of lead varies considerably so that the abundance ratio of these two types of occurrences is different in various pelagic deposits. Dissolved lead in the oceans originates from the chemical denudation of continents, and different drainage regions contribute leads of different isotopic composition to the oceans. The travel time of the dissolved lead which is chemically precipitated is short compared to the mixing time of different large water masses so that lead of a uniform isotopic composition is not simultaneously deposited everywhere on the ocean floors. This phenomenon prevents the use of lead as a chronometric index in lead-rich, uranium-poor marine sediments for intervals shorter than 100 million years. The present rate of soluble lead denudation, free of industrial contamination, is seven times greater than the average rate of chemical precipitation for the Pleistocene. Lead is transported from the continents to pelagic regions in disproportionately greater amounts than uranium and thorium, so that the isotopic evolution of lead in surface materials of the continents is measurably affected, and the lead denuded from some regions of extensively reworked sediments contains abnormally large proportions of Pb^{206}. The gross features of the isotopic variations of leads denuded from continental surfaces can be accounted for by postulating: that these leads have evolved within the continental crust above the Mohorovičić discontinuity; that the crust consists of two phases, an exterior phase of high U/Pb and an interior phase of low U/Pb; that the exterior phase contains lead isotopically homogeneous with the rest of the crust at the time the exterior phase was formed; and that isotopic variations arise from different periods of aging within the exterior phase. The mean isotopic composition of lead to-day within the continental crust is obtained from the intersection of the marine lead isotopic regression line and the primary isochron of zero age for the earth. The values are: $Pb^{206}/Pb^{204} = 18.5_8$, $Pb^{207}/Pb^{204} = 15.7_1$, $Pb^{208}/Pb^{204} = 38.8_7$. (auth)

17895 VALIDITY OF SPECTROGRAPHIC DETERMINATIONS OF TRACE ELEMENTS IN GRANITE G-1 AND DIABASE W-1. Joan M. Rooke and Adrienne M. Fisher (Univ. of Leeds, Eng.). Geochim. et Cosmochim. Acta, 26: 335-42(Feb. 1962). (In English)

New spectrographic analyses for sixteen trace constituents in granite G-1 and diabase W-1 are presented and compared with the latest recommended values. It is suggested that the use of G-1 and W-1 as primary standards may cause serious errors if there are significant differences among samples. Although the statistical evidence does not warrant unqualified acceptance of the validity of the recommended values yet, experience has shown the worth of these two rock samples in improving analytical accuracy. (auth)

17896 THE DETERMINATION OF HAFNIUM AND ZIRCONIUM IN METEORITES BY NEUTRON ACTIVATION ANALYSIS. Erich Merz (Kernforschungsanlage Jülich, Ger.). Geochim. et Cosmochim. Acta, 26: 347-9(Feb. 1962). (In English)

A procedure was developed for determining Hf and Zr together in meteorites, without chemical separation, by means of neutron activation, measuring the induced activities of the nuclides Hf^{181} and Zr^{95} by pulse height analysis. Results of measurements in both iron and stone meteorites are tabulated. (P.C.H.)

17897 ROUTINE MEASUREMENTS OF GROUND-WATER VELOCITY USING S^{35}. W. F. Merritt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys., 8: 185-9(Mar.-Apr. 1962).

A method is described for the measurement of the effective velocity of ground-water movement using S^{35} as a tracer. The method uses modified porous bronze piezometers both for injection of the tracer and sampling of the ground water. S^{35} was used routinely at Chalk River with good results, and a comparison of S^{35} with tritium and fluorescein dye is given. Among the advantages of S^{35} as a tracer is its detectability by simple chemical and counting methods at concentrations well below the maximum permissible values for drinking water. The application of the technique to other problems involving ground water is also mentioned. (auth)

17898 THE USE OF RADIOACTIVE TRACERS IN SEDIMENTATION RESEARCH. J. Roger McHenry and Leslie L. McDowell (U. S. Dept. of Agriculture, Oxford, Miss.). J. Geophys. Research, 67: 1465-71(Apr. 1962).

The transport of sediment was investigated using radioisotopes to "tag" individual sand particles. Sc^{46}, a γ emitter with an 85-day half-life, was employed. The techniques developed for tagging sand particles and the resistance of these tagged sand grains to abrasion and leaching are presented. The method allowed variation of the specific activity of the sand particle as desired. Individual sand particles, about 0.4 to 0.5 mm in diameter, were prepared with an activity of 2 mr per hour, or more, with no changes in the physical properties of the sand. The attenuation of the Sc^{46} emissions were evaluated differentially and integrally using a γ-scintillation spectrometer. The use of a γ-scintillation technique is satisfactory for laboratory studies, including transport studies in flumes. Preliminary field studies indicate that the prepared sand particles perform satisfactorily as tracers for sediment movement. (auth)

17899 AMPLITUDES OF SEISMIC ARRIVALS FROM THE M DISCONTINUITY. Glenn C. Werth, Roland F. Herbst, and Donald L. Springer (Univ. of California, Livermore). J. Geophys. Research, 67: 1587-1610(Apr. 1962).

Theoretical wave forms for the first cycle and a half are calculated for Romney's experimental recordings of underground nuclear explosions Blanca, Logan, and Tamalpais at 96 to 714 km. Models of the crust are constructed from travel times. Zvolinskii's near-front approximation is used to form the basis of amplitude calculations which include head coefficients, geometrical spreading, and corrections for superposed layers. The source function is scaled from measurements made of the Rainier shot. The effects of attenuation and instrument response are included. By convolving these factors, theoretical displacement amplitudes are calculated in millimicrons for the first half-cycle. These agree with measurements from 300 to 600 km, within +4 to −16%. A single-layer crustal model with a Q of about 400 is indicated by the amplitude calculations. The amplitudes of later half-cycles are influenced by the reflection or interaction at the surface of the Rainier mesa. Data and calculations indicate that the surface reflection or interaction is nonlinear and has an amplitude about three times that expected on an elastic basis. (auth)

17900 ESTIMATION OF THE LEVELS OF CAESIUM-137 IN SEA-WATER BY THE ANALYSIS OF MARINE ORGANISMS. Rinnosuke Fukai (Tokyo Regional Fisheries Lab.) and Noboru Yamagata. Nature, 194: 466(May 5, 1962).

Analyses were made of marine organisms instead of large volumes of sea water for Cs^{133} and Cs^{137}. It was felt that this might be a convenient means of estimating the oceanic level of Cs^{137} if an equilibrium was assumed between the two. The concentration of Cs^{133} was fairly constant in several fish species which are popularly consumed in Japan. The standard deviation of the Cs^{133} content in different species around the mean value of 21 μg/kg was ±12%. It was concluded that the estimation of the levels of Cs^{137} in sea water can conveniently be made by analyzing approximately 100 g fresh weight of the whole body of some kind of fish for Cs^{137}, although the estimate represents the concentration of Cs^{137} in sea water of an average in space, depth, and time, and not of a fixed point, reflecting the life history of an organism. Data are tabulated. (P.C.H.)

17901 CESIUM 137 AND STRONTIUM 90 IN SEA WATER. Y. Miyake, K. Saruhashi, Y. Katsuragi, and T. Kanazawa (Meteorological Research Inst., Tokyo). Papers Meteorol. and Geophys. (Tokyo), 12: 85-8(Mar. 1961). (in English)

Concentrations of Cs^{137} and Sr^{90} in the western North Pacific were determined. The content of Cs^{137} ranged from 0.8 $\mu\mu$C/l to 4.8 $\mu\mu$C/l while Sr^{90} of 0.6 to 3.1 $\mu\mu$C/l was contained in sea water. These values are much higher than those obtained in the Atlantic and the eastern part of the North Pacific. The cause of higher contamination is the direct flowout of the fission product from the proving grounds in the tropical region of the Pacific. The reason for the lower ratio of Cs^{137}/Sr^{90} in sea water is also discussed. (auth)

17902 NATURAL RADIOACTIVITY IN GROUND WATER. PART I. Werner N. Grune. Water & Sewage Works, 108: 409-11(Nov. 1961).

A brief history of ionizing radiation and the creation by Congress of a new Division of Radiological Health within the Bureau of State Services is given. Studies made on the finding of radioactivity in a private well water supply in Maine in 1958 are discussed. The development and operation of a special type of combined scaler-scintillation detection system is described. (Public Health Eng. Abstr., 42: No. 4, Apr. 1961).

17903 NATURAL RADIOACTIVITY IN GROUND WATER. PART II. Werner N. Grune. Water & Sewage Works, 108: 449-52(Dec. 1961).

A study was made to develop a simple, reliable, and reproducible method for the analysis of certain naturally occurring radioisotopes in water. The procedures were to be applied to the analysis on ground water supplies during a field sampling program. Requirements differed from those of many analytical methods in that equipment had to be compact and portable. To achieve significant results during a comprehensive field survey, it was desirable that analytical procedures be as rapid as possible without loss of accuracy. Four analytical approaches were studied in the laboratory prior to the field survey: the precipitation of radon^{222} daughters as sulfides with subsequent separation on a millipore filter for analysis by alpha counting; the determination of radon^{222} and lead^{210} by the solvent extraction method used for the separation of lead and bismuth from water; the deenanation of radon^{222} from solution collecting the gases in an Erlenmeyer flask coated with a powdered, silver activated zinc sulfide screen followed by alpha scintillation counting; and analysis of ground water samples by means of gamma emitters. Results of each of the analytical procedures along with the sampling and analytical techniques used are discussed. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962).

17904 NATURAL RADIOACTIVITY IN GROUND WATER. PART III. Werner N. Grune. Water & Sewage Works, 109: 25-9(Jan. 1962).

Aspects of instrumentation and the transistorized detection equipment are discussed. Improved methodology and results of the Maine and New Hampshire field survey are given. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962).

17905 GEOCHEMICAL PROCESS. Howard A. Slack (to Pure Oil Co.). U. S. Patent 3,033,654. May 8, 1962.

A geochemical prospecting process is given for determining the location of subterranean accumulations of petroleum in rock reservoirs overlaid by an impervious cap-rock stratum. The process comprises determining the $C^{12}H_4/C^{13}H_4$ ratio in methane samples collected from a plurality of bore holes in the stratum being investigated. The sampling points are arranged in a lateral pattern so that, although diffusion in the vertical direction may be prevented, fractionation in the horizontal or lateral direction can be detected. (D.L.C.)

17906 SILICA-ALUMINA RADIOACTIVE LOGGING. Stanley E. Turner and Richard L. Caldwell (to Socony Mobil Oil Co., Inc.). U. S. Patent 3,035,174. May 15, 1962.

A neutron-gamma ray logging system is designed for determining the structural character of earth formations by means of measurements of delayed gamma radiation from Al^{28} and Na^{24} produced by fast neutron bombardment of Si and Al, respectively. The system comprises a source of neutrons of energy >2.7 Mev, a gamma-ray detector shielded from the source, means for moving the system in a well bore at such a speed that the delayed gamma rays are detected at any one point ~1 min after cessation of neutron bombardment, energy discriminating means for producing signals proportional to radiation from Al^{28} and Na^{24}, and means for recording the ratio of the signals as a function of depth within the well bore. The system will provide indication of the SiO_2 (e.g., sand) and Al_2O_3 (e.g., clay) content of the stratum and thus give a measure of the permeability of the stratum and its tenacity for petroleum fluids. (D.L.C.)

HEALTH AND SAFETY

17907 (AD-264553) DESIGN OF RECTANGULAR UNDERGROUND STRUCTURES TO RESIST NUCLEAR WEAPONS (thesis). Morris Benton Kinder (Colorado. Univ., Boulder). 1961. 155p.

Design parameters are presented for the design of shallow (5 to 2 ft below grade) underground shelters of rectangular shape for protection against air burst or high surface burst nuclear weapons. Problems presented by dynamic blast loads that change rapidly with time, the design of entrances to withstand and keep out harmful blast pressures, and protection from the initial nuclear radiation and heat are considered. Data are included on blast wave phenomena, loading on underground structures, the seismic velocity of various soils, overpressure in the region of regular reflection, characteristics of nuclear and thermal radiations from nuclear explosions, biological effects of radiation, sheilding materials, structural dynamics, and transformation factors and dynamic reaction equations for a simple beam. A preliminary design procedure is presented that eliminates the necessity of performing a numerical integration on each trial section. The method makes use of several non-dimensional parameters that are expressed graphically in charts for idealized loading and resistance functions. The method is applied in the design of several members for an underground structure. (C.H.)

17908 (AERE-BIB-122(Suppl.I)) TECHNIQUES FOR HANDLING RADIOACTIVE MATERIALS. A Bibliography. A. C. Foskett and C. H. Randall (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1962. 32p.

One hundred and sixty references are presented pertinent to the handling of radioactive materials. The scope does not include the materials themselves except incidentially. (C.H.)

17909 (AERE-M-985) CAESIUM-137 IN DRIED MILK FROM SOUTHERN ENGLAND (1959-61). E. M. R. Fisher and D. H. Peirson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 5p.

Data on monthly averages of Cs^{137} and natural K in milk powder are discussed and presented tabularly. (J.R.D.)

17910 (AI-3739) HAZARDS SUMMARY REPORT FOR THE WALTER REED ARMY MEDICAL CENTER NUCLEAR RESEARCH REACTOR. Heinz H. Cappel (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 6, 1959. 93p.

Includes Supplement No. 1, Dec. 1, 1959.

Detailed descriptions are given concerning the reactor design, operation, location, and the using agency. Potential hazards are evaluated along with safeguards. A supplement is included which further describes the reactor core. (J.R.D.)

17911 (BM-RI-5969) RADIATION HAZARDS ENCOUNTERED IN ARC MELTING THORIUM. R. R. Lowery (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Nov. 1960. 24p.

A project to provide information on the hazards associated with arc melting of Th is described. A general air-sampling analysis was made to determine the separation, concentration, and distribution of Th daughter (decay) products throughout arc melting, machining, and forging processes found in a handling facility. The value of well coordinated health physics program is stressed in connection with potential health hazards and personnel protection. Building, equipment, and exhaust ventilation requirements for such a facility are discussed, along with special handling methods. (auth)

17912 (FXM-420) GAMMA RADIATION FROM A CLOUD FORMED BY AN EXPLODING REACTOR. Paul R. Hill (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). May 22, 1953. Contract AT(11-1)-229. 4p.

Calculations are presented of the γ activity of the fission products in a cloud formed by the explosion of a 400 Mw reactor. Since the fission product activity is directly proportional to reactor power, the results are valid within the limits of the assumptions for any reactor operating at any power. (C.H.)

17913 (FZM-2025) PREDICTING ATMOSPHERIC DISPERSAL OF FISSION PRODUCTS FROM BASIC METEOROLOGICAL MEASUREMENTS. R. L. Seale and J. C. Couchman (Convair, Fort Worth, Tex.). Oct. 12, 1960. 27p.

The problem of predicting atmospheric dispersal of fission products for reactor safety studies is discussed. The method of analysis for diffusion parameters is outlined, and the values of the parameters obtained from the Stanford releases (SO_2), Project Prairie Grass (SO_2), and Field Release Test I and II (fission products) are examined in an attempt to correlate them with meteorological measurements made at the time of release. Good agreement was found between the results calculated from the statistical parameters and the actual experimental data. The effect of cloud meandering is discussed. (D.L.C.)

17914 (NP-11505) SYSTEM OF MEASUREMENT OF ENVIRONMENTAL RADIOACTIVITY IN THE EUROPEAN COUNTRIES OF O.E.C.D., 1961. AIR—FALLOUT. (Organization for Economic Co-Operation and Development, Paris). 1962. 114p.

A report is given on the stations available for measuring the radioactivity in air, precipitation, and fall-out in the European countries of O.E.C.D. as of the beginning of 1961. The administrative organization of each station is reported as well as the sampling and measuring methods. The tables are in two forms: (1) according to subject and country and (2) over-all comparative tables. In all, 165 stations take samples of airborne dust and 196 stations sample fall-out and precipitation. Maps indicating the station locations are given. (D.L.C.)

17915 (NP-11526) ENRICO FERMI ATOMIC POWER PLANT REVISED LICENSE APPLICATION. PART B. VOL. 7. TECHNICAL INFORMATION AND HAZARDS SUMMARY REPORT. (Power Reactor Development Co., Detroit). [1961?]. 128p.

Part A and Part B (Vols. 1 thru 6) identified as NP-10458.

The extent of possible hazards which may result from operation of the Enrico Fermi Atomic Power Plant was evaluated. Prevention of gross meltdown, credible accidents, hypothetical accidents, containment, and hazards external to reactor building are discussed. (M.C.G.)

17916 (NRL-5764) ATMOSPHERIC RADIOACTIVITY AT WASHINGTON, D. C., 1950–1961. Interim Report. L. B. Lockhart, Jr. (Naval Research Lab., Washington, D. C.). Feb. 16, 1962. 18p.

Seasonal variations in the short-lived radon and thoron decay products in the air were observed. The short-term variations of these products are sufficiently great to make impractical the direct determination of gross fission products in the associated air masses without removal of the short-lived natural products through decay, unless the fission product concentration is extremely high. The principal sources of fission products in the Washington, D. C. area have been nuclear tests at the Nevada Test Site (U.S.) and at the Soviet test sites (Novaya Zemlya and Semipalatinsk, for example) with much smaller contributions from those at the Pacific Proving Grounds (U.S.). No radioactive debris from any of the Australia or Christmas Island tests (U.K.) were identified in the Washington collections; only traces of activity were detected from any of the nuclear tests in the Sahara (France). (auth)

17917 (SC-4678(RR)) FALLOUT REPORT: BETA–GAMMA RADIOACTIVITY IN AIR AT SANDIA LABORATORY, FOURTH QUARTER 1961. R. E. Womelsduff (Sandia Corp., Albuquerque, N. Mex.). Mar. 1962. Contract [AT(29-1)-789]. 18p.

A report is presented of the gross beta-gamma radioactivity (expressed as micromicrocuries per cubic centimeter of air) of environmental air samples collected at the Sandia Laboratory of Sandia Corporation during the Fourth Quarter of 1961. (auth)

17918 (TEI-810) POTENTIAL EFFECTS OF PROJECT CHARIOT ON LOCAL WATER SUPPLIES. Arthur M. Piper (Geological Survey, Washington, D. C.). Nov. 1961. 142p.

An order-of-magnitude appraisal of the concentrations of radioactive nuclides that might be introduced into local water supplies by execution of Project Chariot near Cape Thompson, Alaska is presented. Summaires are given of the following environmental characteristics of the area: wind movement, air temperature and permafrost, precipitation, stream flow, evapo-transpiration and soil water, ground-water movement, sediment movement, land-surface types, and potentials for adsorption. Uses of the water and standards for drinking water are discussed. Tables are given showing the expected dispersal of fission products from Project Chariot. It was concluded that radioactivities in streams, due to dissolved nuclides are least for the case of detonation in early August, followed by heavy rains. (M.C.G.)

17919 (WADD-TR-60-827) FEASIBILITY STUDY AND DESIGN OF A SELF-ATTENUATING LIGHT VALVE. John F. Dreyer (Polacoat Inc., Blue Ash, Ohio). Feb. 1961. Contract AF33(616)-6715. 25p. (AD-265431)

The use of phototropic materials as self-attenuating light valves has been re-evaluated in the light of additional information. Sunglass application still appears to be feasible. As eye-protective devices to prevent flashblindness and retinal burns from nuclear detonations, phototropic filters appear to be feasible. However, it is impossible to state that they will provide complete eye protection under all operational conditions until more information is available on the absorption coefficients of the materials and the tolerance of the human retina to short-duration, high-intensity radiation. (auth)

17920 DESIGN OF NEW DIAGNOSTIC X-RAY DEPARTMENTS–PROTECTION ASPECTS. A PAPER READ AT THE ANNUAL CONGRESS OF THE BRITISH INSTITUTE OF RADIOLOGY, APRIL 27, 1961. J. F. B. Dealler (Radiological Protection Service, Sutton, Surrey, Eng.). Brit. J. Radiol., 35: 269-77(Apr. 1961).

The requirements of radiation protection for x-ray diagnostic departments should be included in the considerations of siting and layout of the whole department. The layout of the individual x-ray rooms and the material from which they are constructed have a considerable bearing upon the additional shielding which is necessary, but attention to detail can improve ease of working and reduce capital outlay while still maintaining a very high standard of protection. The incorporation of beam stoppers into x-ray equipment could considerably reduce shielding problems. (auth)

17921 RADIOACTIVE RESIDUAL WATERS. R. Revelle and M. B. Schaefer. Eau, 48: 10-19(Jan. 1961).

Problems of disposing of radioactive wastes and waste waters in the ocean and the effects of such materials on ocean and human life are considered. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962).

17922 THE ROLE OF FLOCCULATION TREATMENT IN THE DECONTAMINATION OF A NATURAL WATER WEAKLY POLLUTED WITH RADIO-ELEMENTS. J. Rodier and J. Scheidhauer. Eau, 48: 101-4(Apr. 1961).

Experiences with the treatment by flocculation of a natural water weakly polluted with radioactive materials are reported. Five elements in particular were studied in connection with waters in the Rhone Valley. Results with different flocculation agents are tabulated. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962).

17923 EFFECTS OF THREE COOKING METHODS ON CESIUM-134 CONTENT OF BEEF FROM ORALLY DOSED STEERS. Bernadine Meyer, Joan Forrester, and M. C. Bell. Food Technol., 16: 110-12(Jan. 1962).

Meat from 10 steers that had been orally dosed with cesium-134 was cooked by 3 methods: roasting, braising, and stewing. The loss of radioactivity from the cooked meat was affected by the surface area exposed to liquid and the amount of water used for cooking. Boneless loin, oven-roasted without added liquid, retained 81% of the radioactivity; top-round steak surface-braised with a small amount of liquid retained 57%; and bottom round stewed with a larger amount of liquid retained 47%. Drippings from roasts contained 13% of the original activity; from steaks, 34%; and from stews, 48%. Less than 1% of the original activity was recovered in the lipid phase of the drippings. With all 3 methods of cooking, over 90% of the original activity was accounted for between the cooked meat and drippings. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962).

17924 PULSE COUNTERS FOR γ-DOSIMETRY. A. R. Jones (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys., 8: 1-9(Feb. 1962).

The application of pulse counters to the measurement of γ doses and dose rates is discussed. Some properties of GM counters and silicon p–n-junction detectors are described as examples. Electronic techniques for handling, displaying, and storing the digital information are presented. The advantages and limitations of pulse counters, as compared with more common detectors providing analogue information, are discussed. (auth)

17925 LIQUID–HYDROGEN HAZARDS ASSOCIATED WITH BUBBLE CHAMBERS. A. A. Weintraub and M. S. Weinstein (U. S. Atomic Energy Commission, New York). Health Phys., 8: 11-15(Feb. 1962).

The hazards of liquid hydrogen as used in bubble chambers, and methods for the control of these hazards, are reviewed and discussed. The principal source of danger lies in malfunction or failure of equipment, releasing gas into the atmosphere with the formation of an explosive hydrogen-air mixture. Important safety considerations are: proper design of equipment and housing facilities, hydrogen control before, during, and after bubble chamber operation, and elimination of ignition sources. Differences in control procedures at various facilities are set forth and research to establish a basis for uniform safety guidelines is described. (P.C.H.)

17926 RADIOLOGICAL SURVEILLANCE OF TOTAL DIETS IN SELECTED LOCATIONS IN THE UNITED STATES. H. F. Kraybill, Catherine Calvert, W. M. Decker, and J. G. Terrill (Public Health Service, Washington, D. C.). Health Phys., 8: 27-33(Feb. 1962).

Sources of data and methods used to survey food consumption are described. Reliable estimates of food consumption are used as a basis for monitoring programs and also for calculating the content of nuclides in total diet. It is pointed out that the composition of the total diet also partly determines the effective ingested dose of radiation to the body. The planning of a total-diet radiological surveillance program in eight selected cities in the U.S. is discussed in terms of the essential criteria used in investigating diet levels of radioactivity for boarding school children. The influence of such factors as age, geographic dietary patterns, socio-economic status, and seasonal variations is discussed not only in terms of food intakes but the resultant levels of radionuclides ingested in foods and total diet. The major indicator foods, contributing the significant levels of Sr^{90} to a total diet in the U.S., are, on a calculated basis, milk products, cereal products, leafy green vegetables, fruits, and root vegetables. (P.C.H.)

17927 QUANTITATIVE MEASUREMENTS OF SOME γ-RAY-EMITTING RADIONUCLIDES IN NUCLEAR INDUSTRIAL WORKERS BY WHOLE-BODY COUNTING TECHNIQUES. F. Swanberg, Jr. (General Electric Co., Richland, Wash.). Health Phys., 8: 67-71(Feb. 1962). (HW-SA-2197)

A summary and an analysis of the K^{40}, Zn^{65}, and Cs^{137} detected and measured by whole-body counting methods in more than 1000 persons during 1960 is presented. The data are the result of a wide sampling of the employees in a large nuclear industrial center. Workers representing all crafts and skills are included. Distributions of the quantitative results and estimates of the mean value for the nuclear industrial population are also presented. (auth)

17928 FALLOUT Sr^{90} IN FOUR STAPLE U. S. FOODS, 1959 AND 1960. Arthur R. Schulert, Rieta Slakter Hirshman, and Karin E. Bartelsen (Columbia Univ., Palisades, N. Y.). Health Phys., 8: 73-80(Feb. 1962).

Cabbage, potatoes, soybeans, and wheat were analyzed for Sr^{90} in nine U.S. cities during 1959 and 1960. The Sr^{90} concentration of wheat in terms of $\mu\mu C$ Sr^{90}/g Ca was found to be about three times that of cabbage, potatoes, or soybeans, whereas in terms of Sr^{90}/unit-wet-weight soybeans have the highest concentration. The decline in Sr^{90} concentrations in some staple cereals and vegetables was not as great as in milk, indicating that foliar uptake is a smaller factor in these crops. The decline in milk concentrations of Sr^{90} in the U.S. is reflected in lower concentration in fetal bone. It is believed that is possible that rainfall, irrespective of its Sr^{90} content, may be an important factor in the uptake of the radioisotope in some plants. (P.C.H.)

17929 A GENERALIZED CONCEPT FOR RADIATION DOSIMETRY. G. S. Hurst and R. H. Ritchie (Oak Ridge National Lab., Tenn.). Health Phys., 8: 117-29(Mar.-Apr. 1962).

The Bragg-Gray principle was successfully employed to measure the absorbed dose in various kinds of matter for ionizing radiation over a wide range of energy. However, with the present large scale application of different types of ionizing radiation and the resulting more stringent requirements for the protection of man against these radiations, it is desirable to characterize the interaction of radiation with matter in several ways. New advances in radiation physics make it possible to approach the problem of dose determination in many more ways. It is shown that, whereas in the Bragg-Gray principle one deals with the total amount of energy absorbed in the radiation detector, in a more general formulation one may deal with various quantities derived from operations on the energy-loss distribution resulting from the interaction of radiation with the detector. Examples are shown to illustrate the flexibility of such a more general statement, and several new approaches to practical problems are suggested. (auth)

17930 SOME FACTORS INFLUENCING THE β-DOSAGE TO TROOPS. R. H. Black (Naval Radiological Defense Lab., San Francisco). Health Phys., 8: 131-41(Mar.-Apr. 1962).

The possibility of combat troops being caught in low-level fall-out fields and suffering from β-produced skin lesions leads to the investigation of possible parameters involved in exposure to β radiation. Volunteers crawled several hundred feet under realistic conditions through test areas contaminated with a dry synthetic fall-out material. The contamination of the subjects was measured in terms of soil loading and β dose from La^{140}. The sources contributing to the total β radiation were: the contaminated field, contamination on the clothing, and contamination on the skin. It was found that soil loading on the clothing was approximately fourteen times that on adjacent exposed skin. However, the clothing provided an attenuation factor of approximately 2 to β radiation so that the contribution from the clothing was about five times that from the contamination on the skin itself. Crawling over a dry grass field resulted in a soil loading on the clothing approximately 60 per cent as great as that obtained on a dry, hard, bare field. (auth)

17931 SIZE-SELECTIVE SAMPLERS FOR ESTIMATING "RESPIRABLE" DUST CONCENTRATIONS. M. Lippmann and W. B. Harris (U. S. Atomic Energy Commission, New York). Health Phys., 8: 155-63(Mar.-Apr. 1962).

A family of size-selective air samplers for field survey work is described. Each sampler operates at a flow-rate suitable to a particular suction source. They all consist of a cyclone collector followed by an efficient filter, and range in capacity from 0.9 l/min to 40 ft^3/min. The collection characteristics of the cyclones were selected so that the fraction of the sample collected on the filter would be equivalent to the material which would penetrate to the non-ciliated portions of the lung. The standard of comparison for collection efficiency is based upon human retention experiments. Representative field data are presented illustrating the relative proportions of respirable and non-respirable dusts at various operations in the uranium and beryllium industries. (auth)

17932 MULTIVARIATE ANALYSIS AND THE IBM 704 COMPUTER APPLIED TO ABCC DATA ON GROWTH OF SURVIVING HIROSHIMA CHILDREN. John V. Nehemias (U. S. Atomic Energy Commission, Washington, D. C.). Health Phys., 8: 165-83(Mar.-Apr. 1962).

Anthropometric data on children exposed to the atomic bomb were collected by the Atomic Bomb Casualty Commission as part of a study of long-term effects of the bomb upon human beings. These data were analyzed, using multivariate techniques with anthropometric measurements as variables, for differences in size, growth rate, and change of growth rate among groups graded roughly according to radiation exposure received. Significant differences were observed among the groups, at all age levels studied, according to size; and among the groups in the postpubertal age levels, according to growth rate and change in growth rate. (auth)

17933 HEALTH PHYSICS ASPECTS OF HANDLING SPENT FUEL ELEMENTS AT THE SAVANNAH RIVER PLANT. R. D. Caldwell (E. I. du Pont de Nemours & Co., Aiken, S. C.). Health Phys., 8: 197-9(Mar.-Apr. 1962).

Routine handling of spent fuel at the Savannah River Plant poses no major health physics problems. However, the handling and disassembly of failed fuel elements are perplexed with problems associated with the contamination of the water in which the elements are handled or stored and the possibility of personnel contamination as a result of working around the contaminated water. The methods and equipment for handling failed fuel elements are discussed. The problems are minimized by passing the water through a decontamination facility containing filters and deionizers. (N.W.R.)

17934 EFFECTS OF BONE ON Sr-89 AND Ca-45 IN BEEF ROASTS. M. C. Bell and R. G. Buescher. J. Am. Dietet. Assoc., 39: 567-8(Dec. 1961).

Radioactive strontium is released from the bone in cooking processes, and the amount found in meat and juices is increased. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962)

17935 METHOD FOR REMOVING CATIONIC RADIONUCLIDES FROM MILK. G. K. Murthy, E. B. Masurovsky, J. E. Campbell, and L. F. Edmondson. J. Dairy Sci., 44: 2158-70(Dec. 1961).

A new method for the removal of radioactive strontium, barium, and cesium from milk was developed. Fresh samples of raw whole milk with added Sr^{85}, Ba^{140}, or Cs^{134} were stored at 4°C for at least 72 hr. The samples were then adjusted to a pH of 5.4 or 5.3 with 0.1 or 0.5 M citric acid and passed through a column containing Dowex 50W-X8 cationic resin in the CaMgKNa cycle. The resin was previously charged with a mixed salt solution containing Ca, Mg, K, and Na chlorides in approximately the same relative proportions as in the milk, but at 5 times their usual concentrations, and at the same pH of acidified milk. After treatment, the milk was mixed with Dowex 2-X8 anionic resin in the OH^- cycle, by the batch process, and the pH was brought to 6.6. The milk was filtered through a cheese cloth to remove the spent resin. Analysis of treated milk indicated that approximately 90-95% of Sr^{85}, 85-95% of Ba^{140}, and 75% of Cs^{134} were removed by this treatment from 25 resin-bed volumes of milk. The removal of radionuclides did not vary with flow rates of 5-25 ml per minute and the cationic composition of the milk was essentially unchanged. Although the milk was not coagulable by rennin, addition of 2-3 ml of 1 M $CaCl_2$ solution per liter of milk yielded coagulum comparable to that obtained with untreated milk. Further treatment of the final product with a CaMgKNa resin at pH 6.6 resulted in an additional removal of approximately 45, 30, and 90% of residual Sr^{85}, Ba^{140}, and Cs^{134} remaining after the initial treatment without further change in the gross cationic composition of the milk. Results obtained at pH 5.2-5.3 with milk labeled in vivo and in vitro were similar. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962)

17936 A SURVEY OF RADIOACTIVE FALLOUT FROM NUCLEAR TESTS. L. Machta, R. J. List, and K. Telegadas (U. S. Weather Bureau, Washington, D. C.). J. Geophys. Research, 67: 1389-1400(Apr. 1962).

The resumption of atmospheric nuclear tests by the Soviet Union renewed interest in radioactive fallout. This and other journals will, in coming months, document the history of the new radioactivity. The passage of radioactive debris through the atmosphere is tracked, and, on the basis of past Soviet tests, geographical areas likely to receive fallout and the levels of fallout that may be deposited next spring are predicted. (auth)

17937 SUPERVISION OF RADIOACTIVE POLLUTION OF MILK. G. Michon. Lait, 41: 273-80(1961).

A scheme for monitoring the radioactivity in milk is outlined. It involves partial analysis in numerous laboratories, more detailed analysis, and the correlation of results in fewer, better equipped laboratories. Dried milk is suggested as the ideal product for such a monitoring system. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962)

17938 THE INFLUENCE OF EMULSION GRANULARITY ON QUANTITATIVE PHOTOGRAPHIC RADIOMETRY. James A. Eyer (Univ. of Rochester, N. Y.). Photo. Sci. Eng., 6: 71-4(Mar.-Apr. 1962).

Granularity limits the accuracy with which the exposure incident upon small areas of a photographic emulsion can be determined, especially for quantitative radiometric measurements using film as the detector. A simple graphic procedure is described whereby the distinguishable density and exposure levels of a specific emulsion or a complete photographic system can be determined. These distinguishable levels define the information storage potential, informational speed, threshold speed, and maximum radiometric accuracy. Some results are given. (auth)

17939 SOME MEDICAL ASPECTS OF THE X-RAY PROTECTION IN INDUSTRIAL RADIOGRAPHY. B. Bugyi, L. Dobrova, and J. Regos. Polski Przeglad Radiol. i Med. Nuklearmej, 26: 171-4(Mar.-Apr. 1962). (In Polish)

Various industrial applications of x rays are discussed and the problem of the occupational x-ray exposure of the working staff is pointed out. The monitoring system in Ganz-Mavag factory in Budapest is presented. A comparison of dosimetric data and clinical findings revealed that although the monthly measured doses recived are low, symptoms corresponding to radiation damage are found in the blood and on the skin of exposed workers. (auth)

17940 CONCERNING RADIATION PROTECTION OF HUNGARIAN MEDICAL X-RAY OPERATIONS. J. Koczkas. Radiol. Clin., 30: 185-9(1961).

Measurements and recommendations are discussed concerning protection against radiation which were made by the health authorities during the last 5 years, in order to achieve the best possible protection in x-ray work. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962)

17941 DOSIMETRIC FUNDAMENTALS IN THE DETERMINATION OF THE VOLUME DOSE IN X-RAY IRRADIATION. H. Luethy (Universitäts'-Institut für Röntgendiagnostik und Strahlentherapie Bürgerspital, Basel). Radiol. Clin., 30: 290-7(1961). (In German)

In a homogeneous water phantom under normal irradiation conditions (70 kv, 2.5 mm Al filter, 45 cm FHD, and 168 cm^2 input field) the isodose distribution was measured. The volume dose thus determined agrees with the value calculated by Mayneord. A large-surface ionization chamber placed in the radiation path, and which completely surrounded the useful radiation beam, needs a dose magnitude with the dimensions $r \times cm^2$. The volume dose can be determined clearly from this magnitude at constant focus-skin distance. Only the tube voltage in kv is a variable. Every surface chamber of this type requires, on account of the very strong wave length dependence restricted by the special construction, an individual calibration. Only under these conditions and with knowledge of the radiation quality is its measurement magnitude a measurement for the volume dose. (tr-auth)

17942 A NEW IONIZATION CHAMBER SYSTEM FOR REGULARLY CHECKING X-RAY THERAPY MACHINES. Leonard Stanton and David A. Lightfoot (Hahnemann Medical Coll., Philadelphia). Radiology, 78: 790-5(May 1962).

Regular and frequent checking of x ray machine output is needed to assure accurate dosage in therapy. Commercial dosimeters are often limited in usefulness by various practical considerations. A system is described which overcomes some of these difficulties. It consists of a monitor ionization chamber mounted beneath the filter, a portable capacitor-electroscope unit, and a charger for this capacitor. The portable unit is first charged so that the electroscope reads 0 mr. It is then plugged across the chamber in the tube housing and the machine is operated at useful factors for a specified time. The resulting milliroentgen reading is an indication of the current x ray output rate. Design and accuracy considerations, as well as test results, are discussed, and areas of potential improvement are noted. (auth)

17943 IODINE-131 DOSE FROM SOVIET NUCLEAR TESTS. Merril Eisenbud, Yoshio Mochizuki, Abraham S. Goldin, and Gerard R. Laurer (New York Univ., New York). Science, 136: 370-4(May 4, 1962).

Observed concentrations of iodine-131 in human thyroid glands and milk in New York City for the period October 9 to December 18, 1961, are reported in order to show the effects of nuclear tests during this period. The first measurements were made about five weeks after the start of testing and about 10 days after iodine-131 was first observed in dairy products in New York City. The accumulation of iodine-131 in human thyroids was observed by in vivo procedures and dissection methods. The human thyroid burdens are shown to be above 10 pC/g, higher than normal, for the milk-drinking portion. (N.W.R.)

17944 PRAKTIKUM PO DOZIMETRICHESKIM PRIBORAM DLYA RENTGENOVSKOGO I YADERNYKH IZLUCHENII. (Manual of Dosimetry Equipment for X-Ray and Nuclear Emission). M. Sh. Vainberg, A. N. Krongauz, R. S. Mil'shtein, V. I. Tryapitsin, and A. V. Frolova. Moscow, Medgiz, 1961. 188p.

Descriptions are given of various dosimetric instruments manufactured and applied in USSR. (R.V.J.)

17945 SEAMLESS ARTICLE. Paul A. Belknap and John J. Keilen, Jr. (to Charleston Rubber Co.). U. S. Patent 3,025,403. Mar. 13, 1962.

A method is given for producing a seamless dipped glove with an incorporated lead compound for radiation protection. The method comprises dipping repeatedly a glove mold into a solution containing an elastomer, a slow curing agent, and a lead oxide until the film deposited on the mold is of the desired thickness, setting and drying the glove, and curing it at 300°F. Two formulas are given for the mold solution, one with neoprene and the other with a butadiene-acrylonitrile copolymer. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

17946 (BNL-5728) APPLICATIONS OF RADIATION TO CHEMICAL PROCESSES. B. Manowitz (Brookhaven National Lab., Upton, N. Y.). Oct. 1961. Contract [AT (30-2)-Gen-16]. 14p.

A discussion is presented concerning radioinduced chemical reactions. The types of radiation considered are electrons, photons, and fission fragments. Included is information on energy deposition, modifications of plastics, use of fission energies and products, and fuels for chemo-nuclear reactors. Flowsheets for polyethylene production and nitrogen fixation are included. (J.R.D.)

17947 (NP-11474) PIERWSZE KRAJOWE SYMPOZJUM ZASTOSOWAN IZOTOPOW W TECHNICE, ROGOW, 8-12 CZERWIEC, 1960. (First National Symposium on Technical Use of Radioisotopes, Rogow, June 8-12, 1960). (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej, Warsaw). 539p.

Fifty-three papers presented at the First National Symposium on Technical Use of Radioisotopes, Rogow, Poland, June 8 to 12, 1960, are given. (M.C.G.)

17948 (AERE-Trans-882) THE EFFECT OF LOW DOSES OF GAMMA-RAYS ON THE PRESERVATION OF VITAMINS IN FOOD PRODUCTS. G. M. Egiazarov. Translated by H. Asher (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Voprosy Pitaniya, 19: No. 4, 54-8(1960). 8p.

The degree of destruction of vitamins A, B_1, B_2, C, E, PP, and carotin under the effect of low doses of ionizing radiation differs according to the type of the vitamin and the nature of the vitamin-bearing product. A fairly high proportion of destroyed vitamin E was noted in cow's milk, butter and sunflower seed oil, while that of carotin was the highest in the beef fat. With a gamma-ray dosage of the order of 50,000 r, accumulation of ascorbic acid could be registered in some foodstuffs (potatoes, carrots) and of thiamine in others (buckwheat and pearl barley). The radiosynthesis thus noted is, apparently, a result of a defensive reaction on the part of the vegetable tissue to the action of high-energy radiation. (auth)

17949 (JPRS-13127) NUTRITIONAL PROBLEMS. Translated from Voprosy Pitaniya, 21: No. 1, 13-18; 45-8; 54-68; 87-92(1962). 48p.

Translations are presented of 6 selected articles. Separate abstracts were prepared on 3 articles covering various aspects of the radiation processing of foods. Other articles include the feeding of burn patients, vitamin deficiency in persons living in arctic regions, and a criteria of human vitamin supplies. (C.H.)

17950 (JPRS-13127(p.16-26)) FOOD PRODUCTS EXPOSED TO IONIZING RADIATION FOR PRESERVATION AND PROBLEMS OF THEIR HYGIENIC EVALUATION. Yu. I. Shillinger. Translated from Voprosy Pitaniya, 21: No. 1, 54-61(1962).

Results are reviewed from a number of studies on the preservation of food products by exposure to ionizing radiation. Problems in the evaluation of irradiated foods are discussed. (C.H.)

17951 (JPRS-13127(p.27-31)) HYGIENIC CHARACTERIZATION OF CERTAIN FOOD PRODUCTS STERILIZED BY GAMMA-RAYS. G. I. Bondarev. Translated from Voprosy Pitaniya: 21: No. 1, 61-4(1962).

The irradiation of beef, cod fillet, green peas, and rye bread was found to cause a considerable change in the organoleptic properties of these products. Dogs that were fed for 11 months on a diet consisting of the irradiated foods showed no toxic symptoms associated with the diet. (C.H.)

17952 (JPRS-13127(p.32-7)) THE EFFECT OF GAMMA RAYS AND THERMAL PROCESSING ON THE DESTRUCTION OF ANTOXIDANTS IN LARD. V. I. Piul'skaya. Translated from Voprosy Pitaniya, 21: No. 1, 65-8(1962).

Chemical changes were found to increase with dose in irradiated fats exposed to oxygen. The oxidative processes in fats were found to develop by a free radical chain mechanism. Butyl hydroxyanisole was found to be an effective inhibitor of the oxidation processes during the storage of lard irradiated with doses of 1,000,000 and 1,500,000 rads. (C.H.)

17953 GAMMA-RAY STERILIZATION AND RESIDUAL TOXICITY STUDIES OF GROUND BEEF INOCULATED WITH SPORES OF CLOSTRIDIUM BOTULINUM. Lloyd L. Kempe and John T. Graikoski. Appl. Microbiol., 10: 31-6 (Jan. 1962).

Inoculated packs of cooked and raw ground beef were sterilized with gamma radiation from cobalt-60. With inocula of 5,000,000 Clostridium botulinum 213B spores per g cooked ground beef, 3.8 megarad were required for sterilization; in raw ground beef, 3.72 megarad sterilized the meat when inocula of 1,700,000 C. botulinum 213B spores were used per g. Using C. botulinum 62A spores, cooked ground beef inoculated with 5,200,000 spores per g was sterilized with 3.85 megarad; raw ground beef, inoculated with 2,670,000 spores per g, was sterilized with 3.6 megarad. Cans of meat that were considered sterile by lack of culture growth after incubation for at least 6 months and, in some instances, as long as 5 years, were tested for the presence of botulinus toxin. No toxin was found in any meat taken from inoculated packs prepared from C. botulinum 213B spores; however, all cans of meat that had been inoculated with more than 2,670,000 C. botulinum 62A spores per g meat, contained type A toxin. It was shown that these latter inocula of heat-shocked spores, by themselves, contained sufficient toxin to kill mice. However, more toxin appeared to be present than could be ascribed to the unirradiated spores alone. (Public Health Eng. Abstr., 42: No. 4, Apr. 1962)

17954 SOME EXHIBITS AT THE ROYAL SOCIETY CONVERSAZIONE, MAY 1961. 1. DETERMINATION OF WOOD DENSITY VARIATION ACROSS TREE GROWTH RINGS A BY MEANS OF β-PARTICLE ABSORPTION. Contemporary Phys., 3: 125-7(Dec. 1961).

The method and equipment used for measuring the density of thin specimens of wood are described. The method shows the change in the annual growth ring from the low spring density to the high summer density. A finely collimated beam of beta particles from carbon-14 scans the strip continuously. Each beta particle that passes through the wood produces a flash of light in an anthracene crys-

tal, a photomultiplier and electronic amplifier magnify the output pulses, and the pulse rate is then registered on a counter. The variation in density is recorded on a graph. The results are accurate within 3% in comparison to weighing methods. The time required to traverse an annual growth ring of 5 mm width is about 12 min. (N.W.R.)

17955 RADIOACTIVE ISOTOPE COMBINATION. Robert B. Costello (to M. W. Kellogg Co.). U. S. Patent 3,017,514. Jan. 16, 1962.

Several radiators consisting of two or more radioisotopes in combination are described for making radiographs of quality comparable to those made with x rays. A composite radiator for metal radiography, particularly of thick steel, comprises Ir^{192}, Sb^{124}, Sc^{46}, and Ta^{182}; the radiations cover an energy band of 0.25 to 2.0 Mev. The possibility of making composite radiators with radiation curves approaching arbitrarily drawn ideal curves is discussed. A composite radiator comparable to Ir^{192} but of extremely long half life and applicable to radiography of materials of a medium thickness, e.g., up to 1.5-inch thickness of steel, comprises 14% Kr^{85}, 84% Ba^{133}, and 2% Cs^{137}. A composite radiator having the penetration capacity of Co^{60} but producing radiographs of quality comparable to those made with x rays, comprises 12% Y^{88}, 18% Na^{22}, and 70% Cs^{134}. (D.L.C.)

ISOTOPE SEPARATION

17956 HEAVY WATER PRODUCTION. E. W. Becker (Institut für Kernverfahrenstechnik, Karlsruhe, Ger.). Review Series No. 21 of "Developments in the Peaceful Applications of Nuclear Energy" of The International Atomic Energy Agency, Vienna. Mar. 1962. 64p. (STI/PUB/15/21). $1.00(IAEA).

Heavy water production processes are described and assessed. It is noted that the H_2S process is most commonly used. Another method for smaller quantities of heavy water is a combination of electrolysis and low-temperature distillation. (J.R.D.)

17957 PROCESS FOR PRODUCING HEAVY WATER. Wolf Vielstich, Walter Rottig, and Herbert Spengler (to Ruhrchemie Aktiengesellschaft). U. S. Patent 3,019,088. Jan. 30, 1962.

A process for producing heavy water is given which consists of a catalytic hydrogenation of carbon monoxide. The process may be carried out with Fe, Co, and Ni catalysts, and an enrichment factor of 1.6 may be obtained with precipitated Fe catalysts. (D.L.C.)

17958 PROCESS FOR ISOLATING ISOTOPES OF ALKALI METALS. André Kepes (to Commissariat à de l'Énergie Atomique). U. S. Patent 3,025,224. Mar. 13, 1962.

A method and an apparatus are described for the isotope separation of alkali metals, especially Li, by countercurrent electromigration through a molten nitrate. The apparatus comprises anode and cathode compartments connected by a horizontal channel; the electrolyte movement is established naturally by electrolysis of the nitrate and may be regulated by slightly inclining the apparatus. Concentrated HNO_3 vapor is used to regenerate the molten nitrate by reaction with the metal deposited on the cathode. (D.L.C.)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 18105 and 18108.

17959 (JINR-D-821) A NUMERICAL METHOD OF CALCULATION OF FEYNMAN GRAPHS. G. I. Kopylov and I. V. Polubarinov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 5p.

For analytical calculations of Feynman graphs, the differential and total cross sections are expressed by the integral of the squared module of the amplitude. The method of random stars is used for integration. The differential cross sections are represented by histograms obtained by averaging the weights, sorted according to values of corresponding variable. This method is directly applicable to the calculation of the contourless graphs, as well as of graphs in which the integration over internal lines is performed beforehand. To calculate the complex number all the operations with the matrices can be carried out with the aid of the electronic computer for all dummy spin indices. (M.C.G.)

17960 (NAA-SR-7137) THE FAIM CODE, A MULTIGROUP, ONE-DIMENSIONAL DIFFUSION EQUATION CODE. D. C. Baller (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1962. Contract AT(11-1)-GEN-8. 89p.

FAIM is a general multigroup, one-dimensional diffusion equation code programmed in FORTRAN language for the IBM 7090 computer. Although the code is basically designed for use in connection with a microscopic cross section library, it is possible to enter macroscopic cross sections in some or all groups and in some or all regions. A major feature of the code is the revised data input consisting of self-explanatory data sheets. There are three types of concentration searches included in the choice of six criticality searches. A data edit including neutron balance is also a feature of the code. (auth)

17961 (NYO-10031) REDUCTION OF CARTESIAN TENSORS AND ITS APPLICATION TO STOCHASTIC DYNAMICS. R. K. Bansal and E. C. G. Sudarshan (Rochester, N. Y. Univ.). Mar. 28, 1962. Contract AT(30-1)-875. 19p.

A Cartesian scheme for the reduction of a fourth-rank tensor is developed which is of particular interest in connection with the stochastic dynamics of spin one systems. (J.R.D.)

17962 (TID-15485) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. MATHEMATICAL METHODS. PART IV. DATA REDUCTION METHODS. PART V. ILLIAC USE AND OPERATION. PART VI. IBM 650 USE AND OPERATION. PART VII. INSTRUCTIONAL USE OF COMPUTERS. PART VIII. CONTROL DATA CORPORATION 1604. PART IX. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Feb. 1962. Contract AT(11-1)-415. 58p.

17963 THE FOCK REPRESENTATION OF THE DUFFIN-KEMMER ALGEBRA. N. A. Chernikov (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 21: 51-60(1962). (In English)

A preprint in Russian published in Mar. 1961 as JINR-P-680.

A representation of the Duffin-Kemmer algebra is constructed using the Fock method. This representation corresponds to a new type of quantum statistics, and is applied to a non-relativistic particle system. (auth)

17964 AN INVESTIGATION OF BIORTHOGONAL POLYNOMIALS DERIVABLE FROM ORDINARY DIFFERENTIAL EQUATIONS OF THE THIRD ORDER. Stanley Preiser (Nuclear Development Corp. of America, White Plains, N. Y.). J. Math. Anal. and Appls., 4: 38-64(Feb. 1962).

The existence is proved of only one ordinary differential equation of the third order of the type $A(x)y''' + B(x)y'' + C(x)y' = \lambda y$ from which biorthogonal polynomials are derivable. The method of proof permits a discussion of differential equations of the first and second order as well, and shows that no first order ordinary differential equation and only five second order ordinary differential equations of the above type will generate biorthogonal polynomials. (auth)

17965 ON THE INDUSTRIALIZATION OF THE ELECTROLYTIC CONCENTRATION METHOD OF HIGHLY ENRICHED HEAVY WATER. I. ELECTROLYTIC CONCENTRATION CASCADE AND CELL. Masami Shimizu, Saburo Nitō, and Akishige Harada. Nippon Genshiryoku Gakkaishi, 4: 180-7(Mar. 1962). (In Japanese)

The commercialization of the electrolytic concentration of highly enriched deuterium oxide comprises: adopting non-mixing cascades with reducing level, and developing an electrolytic cell with reducing level, for concentrating highly enriched deuterium oxide, which indicates $\alpha \approx 8$, in order to recover oxygen and hydrogen separately. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

17966 (BMI-1541(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING AUGUST, 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Sept. 1, 1961. Contract W-7405-Eng-92. 84p.

Progress is reported on development studies on reactor materials and components, fuels, fuel elements, gas-pressure bonding of ceramic fuel elements, uranium carbides, growth of UO_2 single crystals, radioisotope and radiation applications, materials evaluations, coated-particle fuel materials, corrosion in fluoride-volatility processes, cold-bonding processes, radiation effects on MGCR fuel materials, radiation effects on SM-2 fuels, gas-cooled reactor program, and gas-pressure bonding of beryllium-clad fuel elements. (B.O.G.)

17967 (USBM-U-867) QUARTERLY METALLURGICAL PROGRESS REPORT NO. 13, OCTOBER 1, 1961 TO DECEMBER 31, 1961. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Contract AT(11-1)-599. 22p.

The Hf–V and Hf–C phase diagrams are studied. The weight gains in water of as-cast and heat-treated Gd-stainless steel alloys are determined for Gd concentrations up to 35%. Types of alloy systems are determined for 20 binary combinations of Gd, Er, or Dy with metals or Si. Diffusion bonding of Nb–Ta alloys is discussed. The effects of compacting, sintering, and hammer forging operations on mixed powders of gadolinium oxide and Nb are described. Hardnesses, transformation temperatures, and melting points are determined for Th-rich alloys of Ho, Nd, and Pr prepared by nonconsumable-electrode arc melting. Separation of Hf from Zr is accomplished, from fused systems of zircon, potassium silicofluoride, and potassium carbonate. Fractional crystallization of potassium zirconium fluoride from potassium hafnium fluoride in leach liquors is also studied as a separation method. The effects of process variables on damage to cold-mold crucibles are studied. The purity and physical properties of electron-beam-melted Hf is examined. The preparation of 5.46- to 10.97-wt %-C hafnium carbides is reported. UO_2-graphite and U_3O_8-graphite mixes are evaluated for use as consumable electrodes in arc melting. (T.F.H.)

17968 (EURAEC-122) TABLES FOR COMPUTING MEASUREMENTS OF THE DIFFUSION OF RADIOACTIVE INERT GASES FROM SOLIDS AFTER IRRADIATION (DIFFUSION OF INERT GASES IN SOLIDS. 5). Special Report No. 1 [on] DIFFUSION OF FISSION GASES IN REACTOR MATERIALS. K. E. Zimen (Hahn-Meitner-Institut für Kernforschung, Berlin). May 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract [019-60-7RDA]. 39p. Translated from HMI-B-16.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 24842.

17969 AN APPARATUS FOR THE DETERMINATION OF TOTAL HEMISPHERICAL EMISSIVITIES OF METALS. D. A. Howl and A. F. Davis (United Kingdom Atomic Energy Authority, Springfields Works, Preston, Lancs, Eng.). Brit. J. Appl. Phys., 13: 219-22(May 1962).

An apparatus is described for determining total hemispherical emissivities at temperatures above 500°C. The method applies to all metals from which tubes can be fabricated. The tube is heated by passing an electric current through it, and the emissivity is calculated from the power dissipated at equilibrium by the central portion of the tube. Convection and conduction through the gas surrounding the tube are eliminated by enclosing the tube in an evacuated chamber, and conduction losses along the tube itself are calculated from the temperature distribution along the tube. (auth)

17970 EXPERIMENTAL STUDY OF THE ANODE EFFECT WHEN ELECTROLYZING MIXTURES OF FUSED SODIUM CHLORIDE AND ZIRCONIUM TETRAFLUORIDE. C. Decroly and R. Winand (Univ. of Brussels). J. Electrochem. Soc., 109: 443-6(May 1962).

Experiments were made to determine the importance of various causes such as current density, time, temperature, bath viscosity, and nature of the anodic gases of the anode effect in the special case of the electrolysis of ZrF_4 dissolved in molten NaCl. It was found that the critical current density is dependent on the bath composition for anode diameters of 16, 32, and 64 mm. For pure NaCl the critical current density is rather small. When adding ZrF_4 it begins to increase, has a maximum for about 5 wt % of ZrF_4, then decreases slowly with increasing concentration of ZrF_4. An explanation of the decrease might be that when the proportion of zirconium fluoride increases the vapor pressure of the salt increases also, a phenomenon which could have an influence on the anodic processes. However, the main factors found to play an important part in the processes involved in the anode effect are: wettability of the electrode by the bath, nature of the gas evolved by the normal anodic reaction, and the hydrodynamics of the gas evolution. (P.C.H.)

17971 STATUS AND FUTURE OF GRAPHITE AND REFRACTORY COMPOUNDS. R. T. Dolloff and J. T. Meers (National Carbon Co., Parma, Ohio). J. Metals, 14: 351-4(May 1962).

The degree of success achieved by graphites and certain refractory compounds in fulfilling the need for construction materials of superior properties at high temperatures is discussed. Topics covered are specialized graphites, oxidation resistance, special properties, mechanical behavior, and refractory hard metals. (M.C.G.)

17972 RUBIDIUM AND CESIUM, WHERE ARE THEY GOING? C. E. Berthold (American Potash and Chemical Corp., Trona, Calif.). J. Metals, 14: 355-8(May 1962).

The occurrence, extractive metallurgy, and uses of rubidium and cesium are described. (M.C.G.)

17973 BUREAU OF MINES WILL HAVE VERSATILE Co^{60} INSTALLATION. John E. Crawford (Bureau of Mines, Washington, D. C.). Nucleonics, 20: No. 5, 100; 102-3 (May 1962).

The 132,000-curie cobalt-60 irradiation facility at the Albany (Oregon) Metallurgy Research Center includes a large cell equipped with two viewing windows and two pairs of master-slave manipulators, and a 17-ft well for storage of the cobalt-60. The installation with its high-intensity gamma irradiator will be devoted solely to research in coal and petroleum technology and metallurgy. Twenty-four preirradiation encapsulated slugs will be used in a 30-in. long by 15-in. diameter cylindrical array

to give dose rates as large as 10^7 r/hr. Both static and dynamic tests will be made with the facility. The cell 8 × 12 ft with a ceiling height of 12 ft, has 4-ft thick walls of high density magnetite concrete and a 3½-ft roof. Both the walls and roof are lined inside with ¼-in. mild-steel sheet covered with radiation-resistant paint. (N.W.R.)

17974 METALLURGY OF THORIUM PRODUCTION. B. Prakash, S. R. Kantan, and N. K. Rao (Atomic Energy Establishment, Trombay, India). Review Series No. 22 of "Developments in the Peaceful Applications of Nuclear Energy" of the International Atomic Energy Agency, Vienna. Mar. 1962. 61p. (STI/PUB/15/22). $1.00 (IAEA).

An outline of the occurrences of the important thorium bearing minerals is presented. Different methods of processing the most important economic thorium bearing mineral, monazite, are critically reviewed, together with methods of purifying the thorium compounds to a nuclear grade. Also described are the metallothermic and other methods of producing thorium metal, and the melting and fabrication of thorium, including the power metallurgical techniques. The health and safety aspects of working with thorium and its compounds are briefly dealt with. The position of thorium in the field of nuclear power reactors today is in the nature of a reserve material. Current and future developments will provide an impetus for new and wider uses of the metal for power generation. (auth)

Corrosion

17975 (CVNA-113) DEVELOPMENT OF FABRICATION PROCEDURES FOR CONSTRUCTION OF THERMAL BAFFLES, INCLUDING PREOXIDIZING OF ZIRCALOY. Terminal Report. E. Landerman and C. J. Kubit (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh) Sept. 5, 1961. For Carolinas-Virginia Nuclear Power Associates, Inc., Charlotte, N. C.). Contract AT(30-1)-2289. 94p.

A fabrication development program was conducted on Zr alloy thin wall thermal baffles for CVTR. Thermal baffles were fabricated for the CVTR In-Pile Loop Test, also the Phase I and Phase II thermal and hydraulic out-of-pile tests. Baffle fabrication procedures were developed which consisted of cold forming, W inert gas (TIG) welding, vacuum annealing, and final cold drawing to obtain the required dimensional tolerances. In addition to thermal baffle fabrication, pre-oxidation of Zr and Zr alloys was investigated for providing a protective oxide film. The technique for pre-oxidation in pure dry O was developed as an alternate method to the autoclave corrosion test for obtaining a protective oxide film on thermal baffles and other CVTR Zr alloy components. Pre-oxidation resulted in lower H pickup, simpler test procedures, and less cost as compared with conventional steam autoclave corrosion testing. (auth)

17976 (EURAEC-94) CORROSION OF NUCLEAR MATERIALS. Quarterly Report No. 3, September 1 to November 30, 1960. Volume 1. (Brussels. Centre Belge d'Etude de la Corrosion; Brussels. Centre d'Etude de l'Energie Nucleaire; and Brussels. Societe d'Etudes, de Recherches et d'Applications pour l'Industrie). Dec. 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract [007-60-3-RDB]. 114p.

A summary is given of potentiodynamic, potentiostatic, corrosimetric, and chronopotentiometric investigations of the corrosive effects of chemicals, both in the presence and in the absence of radiation fields. Principal attention is devoted to stainless steel, but Al, Fe, steel, Pt, Au, Cu, Mo, and Zr are also studied. Corrosive materials investigated include TiC, Cr_4C, NaCN, H_2SO_4, HNO_3, $NaHCO_3$ + NaCl, $NaNO_3$ + $(NH_4)_2HPO_4$, and NH_4NO_3 + B_2O_3, $(NH_4)_2PO_4$, or $(NH_4)_2HPO_4$. (T.F.H.)

17977 (EURAEC-141) CORROSION PROBLEMS. Quarterly Activity Report No. 5, April 1, 1961 to June 30, 1961. (Brussels. Centre Belge d'Etude de la Corrosion; Brussels. Centre d'Etude de l'Energie Nucléaire; and Brussels. Société d'Etudes, de Recherches et d'Applications pour l'Industrie). July 1961. Work performed under United States–Euratom Joint Research and Development Program. 114p.

A report is presented of studies on potentiokinetic, potentiostatic, and corrosion behavior of stainless steel, carbon steel, and Al. Other work is also reported on the chronopotentiometric behavior of Al, Al alloys, Zr, and Fe. Also, loop tests in the Br-1 reactor are described. A description of experimental conditions is included along with test results. (J.R.D.)

17978 (EURAEC-175) CORROSION PROBLEMS. Quarterly Progress Report No. 6, July 1 to September 30, 1961. (Brussels. Centre Belge d'Etude de la Corrosion; Brussels. Centre d'Etude de l'Energie Nucléaire; and Brussels. Société d'Etudes, de Recherches et d'Applications pour l'Industrie). Oct. 1961. Work performed under United States–Euratom Joint Research and Development Program. 69p.

Continuation of electrochemical studies is reported on stainless steels, boiler steels, Al, Al alloys, Zr, and Fe. The behavior of stainless steels was studied in bicarbonate solutions, while carbon steels were exposed to alkaline solutions. Continued potentiokinetic study of Al and Al alloys in ammonium phosphate solutions is also reported. Loop tests in the Br-1 Reactor were carried out to compare the behavior of stainless steel and Al in solutions with and without radiation. (J.R.D.)

17979 (GCM/UK/26) THE OXIDATION OF GRAPHITE SINGLE CRYSTALS. J. M. Thomas and Glenda Hughes (University Coll. of North Wales, Bangor). Mar. 1962. 16p.

Presented at Libby-Cockcroft Meeting on Gas Coolant Compatibility, Harwell, Berks, England, April 1962.

Issued by U.K.A.E.A. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

The nature of etch pits on the {0001} planes of natural graphite was studied using carbon dioxide and oxygen. Marked differences were observed in the mode of graphite attack by oxygen and carbon dioxide, and the way in which hydrogen pre-treatment modified subsequent oxidation by oxygen. Changes in the reaction mechanism during oxidation were observed by alterations in the shape of the etch pits. (M.C.G.)

17980 (KAPL-M-AA-1) THE CORROSION BEHAVIOR OF ZIRCALOY-2 IN 900F STEAM. A. M. Andrako and B. E. Dearing (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 1, 1962. Contract W-31-109-Eng-52. 24p.

Certified reactor-grade Zircaloy-2 showed extremely erratic corrosion behavior at elevated temperatures (800 to 1200°F). This erratic corrosion behavior existed between adjacent samples taken from a rolled strip as well as between samples taken from different strips. An attempt was made to isolate and define the factors affecting this high temperature corrosion behavior. The variability may be due to an extreme sensitivity to sample preparation and/or

testing parameters and to small variations in chemical composition, particularly iron and nickel. Specimen shape was found to be an important factor in high temperature evaluations of Zircaloy-2 since edges are subject to preferential attack. The test also showed the danger of extrapolating low temperature Zircaloy-2 corrosion data for high temperature design criteria. (auth)

17981 (ORNL-2943) DETERMINATION OF THE EFFECT OF HIGH EXCESS H_2SO_4 CONCENTRATIONS ON THE RADIATION-INDUCED CORROSION OF ZIRCONIUM AND TITANIUM ALLOYS IN 0.17 m UO_2SO_4. G. H. Jenks and J. E. Baker (Oak Ridge National Lab., Tenn.). May 1, 1962. Contract W-7405-Eng-26. 57p.

An in-pile loop experiment (L-2-14) was carried out with the primary objective of studying the effects on Zircaloy-2 radiation corrosion of a high concentration of excess H_2SO_4 in a uranyl sulfate test solution. Previous results obtained in in-pile autoclave experiments had shown a beneficial effect of H_2SO_4 additions. The effect could be correlated with a reduction of the U content of the heavy scales (and consequent reduction in local intensity of fission recoils) found on the surfaces of Zircaloy-2 specimens. Because Zircaloy-2 specimens exposed in in-pile loop cores are free of heavy scales of the type found in autoclaves—a result of transport to unirradiated surfaces—it was not obvious that acid addition would actually reduce the corrosion of Zircaloy-2 exposed in loops or in the practical reactor systems which the loops simulate. The solution was 0.17 M in UO_2SO_4, 0.15 M in $CuSO_4$, and 0.4 M in H_2SO_4, in H_2O. Temperatures in the main stream and pressurizer were 280 and 300°C respectively. The loop was constructed of Ti. Specimens of Zircaloy-2, Zr-15 Nb, Ti-55A, and Ti-6 Al-4 V were tested. The loop operated in beam hole HB-2 of the LITR for 663 hr, during which time the reactor output was 1530 Mwhr. The experiment was terminated when the loop pump failed. The corrosion rates of Zircaloy-2 coupons exposed in the core of the loop varied from 2.6 mils per year (mpy) at 5.5 w/ml to 5.1 mpy at 12.8 w/ml. Zircaloy-2 corrosion rates at similar power densities in previous 280°C loop experiments employing solutions that were 0.17 M in UO_2SO_4 but only 0.02 to 0.03 M in excess H_2SO_4 and 0.015 M in $CuSO_4$ were significantly higher than those in the present experiment. Since the loop specimens were free of heavy scales of the types found in autoclaves but in general retained thin-appearing films, it is concluded that U sorption must occur on or in the films and that, in accordance with those autoclave experiments that demonstrated reduced U sorption and corrosion rates in solutions containing high concentrations of excess H_2SO_4, the reduced Zircaloy-2 corrosion rates exhibited in the loop experiment were also a result of decreased sorption of U in or on the thin films. (These conclusions have been substantiated by subsequent experiments.) The crystal-bar Zr coupons in the loop core exhibited corrosion rates in excellent agreement with the Zircaloy-2 data. However, the Zr-15 Nb core coupons exhibited rates that were approximately 2.5 to 4.5 times greater than those observed for the Zircaloy-2 specimens at similar power densities. This is in contrast to data from previous experiments in which Zr-15 Nb core coupons exhibited rates lower than those of the Zircaloy-2 coupons. (auth)

17982 (ORNL-2962) IN-PILE LOOP INVESTIGATIONS OF CORROSION OF ZIRCALOY-2 AND OTHER POSSIBLE REACTOR MATERIALS IN 0.04m UO_2SO_4 AT 280°C. G. H. Jenks and J. E. Baker (Oak Ridge National Lab., Tenn.). May 5, 1962. Contract W-7405-Eng-26. 43p.

In-pile loop experiment L-2-10 was one of a series designed to test the radiation corrosion of Zircaloy-2 and other possible reactor construction materials in UO_2SO_4 solutions under various radiation intensities, temperatures, solution compositions, and velocities of flow past specimens. The solution employed was 0.04 M UO_2SO_4, 0.0075 M $CuSO_4$, and 0.02 M H_2SO_4 in H_2O. Radiation exposure was carried out in the LITR HB-2 facility, at a main-stream temperature of 280°C. Construction material for the loop was type 347 stainless steel. Specimens of Zircaloy-2, Ti-55A, platinum, and types 347 and 309 SCb stainless steel were tested. The power density at core specimens ranged from a maximum of 4.2 to a minimum of 0.8 w/ml. The total time of high-temperature operation with UO_2SO_4 solutions was 1872 hr, of which 1672 hr was with enriched UO_2SO_4. In-pile circulation time for this experiment (following the initial reactor startup) was 1456 hr, and the reactor energy was 3765 Mwhr, with most of the energy accumulated at the 3-Mw power level. The over-all corrosion rate of steel in the loop decreased slightly with time of exposure. The average over-all steel rate based on oxygen data and radiation time was 0.47 mpy (mils per year). The average rate based on nickel data was less than 0.3 mpy, but the nickel results are believed to be low because of sorption of this material on corrosion product oxides. The average and maximum rates for type 347 stainless steel channel specimens outside the core were 0.18 and 0.45 mpy, based on weight loss data, exposed-area attack, and radiation time. The comparably determined minimum and maximum rates for channel specimens in the core ranged from 0.1 to 2.8 mpy, with the rate increasing in an apparently regular fashion with increasing power density above about 2 w/ml. Below this power, the rates were about the same as those observed in-line. There was no apparent effect of varying solution velocities in the range 10 to 40 fps on either the core channel or in-line channel specimens. Specimens of types 347 and 309 SCb stainless steel exposed on one assembly in the core annulus region corroded at much higher rates than core channel specimens, but annulus steel specimens on another similar array corroded at somewhat lower rates than the channel specimens. The explanation for this difference is unknown. Differences in galvanic action between the specimens located on each of the assemblies is considered the most likely explanation, but no detailed mechanism is suggested. Zircaloy-2 corrosion results from this loop are discussed and correlated elsewhere in terms of the 280°C relationship between corrosion rate R (mpy), power density P (w/ml), and uranium sorption factor α: $1/R = 2.23/P\alpha + 1/40$. The data from this experiment obey this relationship. The value of α for core annulus specimens, which were exposed to a velocity of about 0.8 fps, was 6.9. For the exposed surfaces of those channel specimens located in the convergent section of the channel and exposed to average velocities of 19 and 33 fps, the best estimates of α are in the range 1 to 1.8. Specimens located in the divergent section of the channel exhibited higher α values. Results for Ti-55A specimens indicated that in-pile titanium corrosion was affected by some uniform change in the solution under radiation to a greater extent than by fission recoil irradiation of specimen surfaces or by the fissioning taking place in the solution immediately adjacent to specimens. However, the result obtained with one core specimen exposed to the highest average solution velocity (35 fps) suggested that the susceptibility of this material to adverse velocity effects is increased by exposure to fissioning solution. With the exception of this one specimen, the average rate (based on radiation time and total area) for core channel speci-

mens was 0.8 mpy, compared with an average of 0.7 mpy for in-line specimens. The similarly determined rate for the high-velocity specimen was 3.6 mpy. Platinum corrosion was negligible. There was no evidence of solution instability. Some discrepancies in analytical results were ascribed to sampling and analytical errors. (auth)

17983 ON THE OXIDATION OF ZIRCONIUM. Karl A. Sense (Atomics International, Canoga Park, Calif.). J. Electrochem. Soc., 109: 377-82(May 1962).

The rate law for the oxidation of zirconium was found to be initially intermediate to linear and parabolic, then parabolic, and then nearly cubic over the first 10-min interval at both 400 and 500°C. At 400°C the oxidation rate became parabolic for an oxide thickness of about 300Å. At 500°C the oxidation rate became nearly cubic at about 3300Å, the transition from one rate to another being gradual rather than sharp. The activation energy for the parabolic region was 29.3 kcal/mole and for the nearly cubic region approximately 42 kcal/mole. The results obtained were independent of the shape of the specimen and its surface preparation. An analysis shows that the high solubility of oxygen in zirconium is not a sufficient condition to account for a cubic rate law of oxidation for a concentration-independent diffusion constant. (auth)

17984 INHIBITION BY BORIC ACID OF THE OXIDATION OF ZIRCONIUM IN HIGH PRESSURE STEAM. C. F. Britton and J. N. Wanklyn (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 326-7(Apr. 1962). (In English)

A substantial reduction in the corrosion of iodide zirconium exposed to high pressure steam has been obtained by adding boric acid to the steam. In steam only at 500°C and 1000 psi (68 at.), iodide zirconium is almost completely oxidised in 24 hours, weight gains of about 5400 mg/dm^2 being obtained. Inhibition by boric acid reduces the weight gain to about 30 mg/dm^2 in 24 hours, increasing to only 120 mg/dm^2 at 70 days' exposure. No marked reduction in corrosion rate occurred with a more corrosion-resistant alloy of zirconium (0.5 wt % Cu, 0.5 wt % W), although a small reduction was obtained with zircaloy 2. Somewhat less effective inhibition was obtained by alloying zirconium with up to 1.0 wt % of boron. Boric acid was shown to suppress the heavy localized corrosion experienced by iodide zirconium in uninhibited steam. Capacity measurements of films formed in inhibited steam showed them to be less cracked than those formed in the absence of boric acid. Hydrogen uptake, as a function of weight gain was, however, unaffected. A few experiments suggested that the corrosion of aluminum and beryllium may also be inhibited by boric acid. (auth)

17985 THE CORROSION OF BERYLLIUM AND ALLOYS OF BERYLLIUM WITH CALCIUM IN CARBON DIOXIDE. T. Raine and J. A. Robinson (Associated Electrical Industries Ltd., Manchester, Eng.). J. Nuclear Materials, 5: 341-3(Apr. 1962). (In English)

The addition of Ca metal to Be in amounts greater than 0.15 wt % resulted in the development of a range of Be alloys of outstanding resistance to corrosion at 700°C in CO_2 gas at a pressure of 20.5 atm. The resistance to corrosion of the alloys in CO_2 increases with increasing Ca content. The addition of Ca to Be also modifies the pressure dependence of the corrosion reaction and the type of corrosion observed. (C.H.)

17986 THE EFFECT OF HALIDE IONS ON THE ANODIC PASSIVATION OF ZIRCONIUM. Akimi Umezono and Susumu Morioka (Tohoku Univ., Japan). Trans. Japan Inst. Metals (Sendai), 2: 163-7(July 1961). (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 11530.

17987 INVESTIGATION OF THE CORROSION RESISTANCE OF SOLID SOLUTIONS OF Mo–W. N. N. Gratsianskii and N. A. Bogacheva (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zhur. Fiz. Khim., 36: 546-8(Mar. 1962). (In Russian)

The corrosion resistance of solid solutions of Mo–W in aqua regia and nitric-oxalic acid solutions at room temperature was investigated. The corrosion resistant boundary in the first solution arises at 20 at.% W content in the alloy and in the second solution at about 50 at.%. The main cause of the corrosion resistant boundary is the formation of a phase consisting of a compound of the metals and the corrosion resistant surface layer, 0.1–0.2 microns thick, of almost pure tungsten. With 20 at.% tungsten the main cause is the formation of the corrosion resistant layer. One of the factors influencing the position of the corrosion resistant boundary on the composition-corrosion resistance diagram is the nature of the corrosive solution. (auth)

17988 EFFECTS OF OXIDIZING ADMIXTURES IN HYDROCHLORIC ACID ON THE CORROSION AND ELECTROCHEMICAL BEHAVIOR OF Zr AND Zr–Ti ALLOYS. A. I. Glukhova and V. V. Andreeva (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Prikład. Khim., 35: 567-72(Mar. 1962). (In Russian)

The effects of oxidizers in hydrochloric acid on the corrosion and electrochemical behavior of Zr and Zr–Ti alloys were analyzed. The Zr–Ti alloys were prepared from iodide metals with a Hf content not exceeding 0.04%. Zirconium alloys with over 40% Ti exhibited the highest resistance to corrosion. (R.V.J.)

17989 ORGANIC INHIBITORS IN Ti CORROSION IN SULFURIC ACID. A. P. Brynza and L. I. Gerasyutina (Dnepropetrovsk State Univ., USSR). Zhur. Prikład. Khim., 35: 683-5(Mar. 1962). (In Russian)

Studies of organic inhibitors of 1.5 mm-thick sheet BTI-2 Ti alloys (0.09% Fe, 0.03% Si, 0.10%C, and 0.05% Ni) corrosion in sulfuric acid showed that n-nitroanilin, m-nitroanilin, n-aminophenol (oxidized), n-nitrophenol, 2,4-binitrophenol, nitrobenzene, and o-nitroanisol are effective in protecting the surface. (R.V.J.)

17990 EFFECTS OF ALUMINUM, COPPER, AND ZINC ON MAGNESIUM RESISTANCE TO CORROSION CRACKING. V. V. Romanov. Zhur. Prikład. Khim., 35: 795-802(Apr. 1962). (In Russian)

Investigations of the effects of Al, Cu, and Zn on the mechanical properties and corrosion of Mg in 35g/l NaCl and 0.01 n H_2SO_4 + 35g/l NaCl showed that increased admixtures of Al improve mechanical properties but reduce corrosion cracking resistance. Additions of Zn improve the mechanical properties, do not affect corrosion resistance, but increase the cracking rate. Cu reduces both the resistance to corrosion and corrosion cracking, but does not improve the mechanical properties. (R.V.J.)

17991 GROWTH OF SOLID LAYERS ON SUBSTRATES WHICH ARE KEPT UNDER ION BOMBARDMENT BEFORE AND DURING DEPOSITION. Gottfried K. Wehner (to General Mills, Inc.). U. S. Patent 3,021,271. Feb. 13, 1962.

A method is given for growing solid layers on substrates by sputtering, e.g., growing single crystals and layers which are atomically bonded to the substrate. The method comprises immersing the substrate and material to be deposited as separate electrodes in a low-pressure high-

density gas discharge plasma, particularly a d-c mercury vacuum arc plasma at ~1 μ Hg pressure between a pool-type cathode and an anode; cleaning the surfaces of the substrate and material by ionic bombardment; and sputtering atoms of the material onto the substrate at a rate less than a critical value for atomic bonding. Two examples of the method are given in which Ge and Si are sputtered onto Ge substrates. (D.L.C.)

Fabrication

17992 (AD-265840) ROLLING IMPROVED BERYLLIUM SHEET. Quarterly Report No. 1, July 5, 1961 to October 4, 1961. Technical Report 231-234. E. M. Grala, R. G. O'Rourke, G. L. Marsh, and L. S. Busch (Brush Beryllium Co., Cleveland). Contract AF33(600)-43037. 24p.

An improved Be sheet with high mechanical properties in a flat condition with good reproducibility is being developed. A review of literature concerned with Be sheet production was made. Investigations of rolling parameters and processes, isotropic ductility, pilot production, and production are planned. The investigation of rolling parameters was initiated. Preliminary studies were initiated on the isotropic ductility phase of the program. Finishing operations on currently produced Be sheet are being investigated. (auth)

17993 (ARF-2212-4) DEVELOPMENT OF DUCTILE BERYLLIUM COMPOSITES. Bimonthly Report No. 4, July 18, 1961–September 17, 1961. Frank A. Crossley (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Sept. 17, 1961. Contract NOw-61-0370-c. 6p. (AD-263678)

Progress is reported on the development of ductile Be composites consisting of Be particles in a ductile matrix. The vacuum chamber is now in operation. This chamber will permit pressure liquid-phase sintering in vacuum. Tensile tests and hardness evaluations of heat-treated binary alloys spanning the Ag–Al system indicate that the correct matrix can be found which satisfies the strength and ductility requirements for the attainment of ductile beryllium composities. (auth)

17994 (CNLM-1758) WELDABILITY OF HAYNES ALLOY NO. 25. Final Report. S. L. Rogers (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). May 19, 1959. Contract [AT(11-1)-229]. 7p.

The fusion welding characteristics of Haynes No. 25 alloy are described. (J.R.D.)

17995 (DP-691) FABRICATION QUALITY OF HWCTR DRIVER TUBES. Richard C. Pugh (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Mar. 1962. Contract AT(07-2)-1. 16p.

The uniformity and quality of driver tubes that will be used for operating the Heavy Water Components Test Reactor at the Savannah River Plant are discussed. The tubes are about 9½ feet long and 2.3 inches in diameter. The Zircaloy-clad core consists of a zirconium alloy containing 9.3 wt % uranium of 93% enrichment. The methods for measuring driver tube quality are discussed along with the results obtained on an initial development order for fifty driver tubes. Fifty-three driver tubes were produced that were satisfactory in all respects. (auth)

17996 (EURAEC-4) PRODUCTION OF MIXED UO_2–ThO_2 OXIDE PELLETS BY SINTERING IN AIR. Quarterly Report No. 1. (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). Dec. 15, 1960. Work performed under United States–Euratom Joint Research and Development Program. Contract 014-60-9RDF. 25p.

A description is given of a method for preparing crude pellets. Sintering tests were made in H (cracked ammonia). The sintering process was accelerated by raising the density in the rough and by adding CaF_2, $CaCO_3$, or MgO. It was found that the presence of UO_2 generally lowers the density after sintering. Tests were begun for sintering-in-air. (B.O.G.)

17997 (EURAEC-13) URANIUM OXIDE EXTRUSION. Quarterly Report No. 2. (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). Mar. 15, 1960. Work performed under United States–Euratom Joint Research and Development Program. Contract [030-60-9RDF]. 22p.

Cylindrical revolution rods were fabricated by Rhodoviol extrusion of UO_2 of specific surface area. The influence of the bond type, granulation method, die characteristics, surface layer of the crude rods, and sintering conditions on the densification, appearance, and deformation of the sintered rods were studied. The Rhodoviol extrusion of UO_2 to which, a wetting agent was added, followed by sintering under load, enabled the fabrication of sintered rods. (B.O.G.)

17998 (EURAEC-112) WET PREPARATIONS OF UO_2 POWDERS. Second Quarterly Report, April–June 1961. (Italy. Comitato Nazionale per l'Energia Nucleare. Divisione Materiali, Rome). June 30, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 028-60-10-RDI. 42p.

Development of a chemical process for production of uranium hydroxide is described. Special attention was devoted to the constant nature of the precipitation yield and impurity content. Good reproducibility was obtained in drying and inactivation by heating in H at 600°C followed by cooling in H, and inactivation in N with 2% O. Research was also conducted on other drying methods involving the use of N. Development of a standard sintering process for evaluation of prepared powders continued with the emphasis on wet-machining. Effects of grain size on sinterability was studied along with temperature effects on final density. (J.R.D.)

17999 (EURAEC-113) STEAM SINTERING OF URANIUM DIOXIDE. Progress Report No. 3, April 1–June 30, 1961. (FIAT. Sezione Energia Nucleare, Turin). July 31, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 016-60-9RDI. 15p.

The steam sintering apparatus was completed and checked. The occurrence of thermal shocks leading to ruptures in the combustion tube showed the requirement for design changes which were made. A newly designed steam differential thermal analysis setup was put in operation to take care of the short-comings of the previous arrangement. Preliminary experiments are in progress. Heat treatment of UO_2/U_3O_8 mixtures was hindered by oxidation and reduction in the furnace. The mixtures are being re-prepared and treated with better care. (auth)

18000 (EURAEC-119) EXTRUSION OF URANIUM OXIDE RODS. Quarterly Report No. 3, April–June 1961 (Second Year Quarterly Report No. 7). (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine et Oise), France). Work performed under United States–Euratom Joint Research and Development Program. Contract [030-60-9RDF]. 27p.

The extruded rods obtained, when using uranium oxide powder of low specific area, had a density of 10.40 to 10.45 gm/cm^3, or more than 95% theoretical density. These cylindrical rods were obtained by uranium oxide extrusion with gum tragacanth in the presence of $AlCl_3$ with isostatic compression. Research on the application of additives to increase the rod density was continued. (auth)

18001 (EURAEC-124) FABRICATION OF URANIUM AND MIXED CARBIDES AND UC-BASED CERMETS, CORROSION PROCESSING AND PROPERTY TESTS. Quarterly Report No. 4, April–June 1961. Appendix 1 to NUKEM letter dated July 31, 1961. P. Himmelstein, F. Hofmann, B. Liebmann, O. Neumann, and L. Schaefer (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work performed under United States–Euratom Joint Research and Development Program. Contract [012-60-5RDA]. 8p.

Fabrication of UC from UO_2 and graphite was continued. Pellets fabricated at 1550°C gained weight at the rate of 0.05% in 8 weeks in 60% humidity air and at the rate of 1.2% in saturated air. The grain sizes in ground UC from solidified melt were found to correspond to the size required for swaging and compacting. (J.R.D.)

18002 (EURAEC-193) SWAGING OF URANIUM DIOXIDE. Quarterly Progress Report No. 5, July 1, 1961 to September 30, 1961. (FIAT. Sezione Energia Nucleare, Turin). Oct. 31, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 059-61-7RDI. 18p. (FN-E-13)

The pre-compaction and cold swaging study of reactor-length rods were completed. An improvement in the pre-compaction apparatus efficiency was obtained and vibrated densities of over 86% theoretical were reached with fused UO_2. Cold swaged densities of 92 to 93% theoretical are obtainable with only 2 passes, a reduction of fuel area of less than 20%, and a relatively low tube elongation value (approx. 10%). The research will now be centered on the study of the uniformity and reproducibility of swaged bars. An investigation on the use of ceramic grade UO_2 powder for swaging-annealing experiments was initiated. The swaged UO_2 testing development is in progress. The experimental setup for thermal conductivity measurement was modified in order to perform runs at temperatures higher than 500°C. A study of the open porosity of swaged UO_2 was initiated by means of the pressurized Hg technique. Fragmentation of fused UO_2 during swaging is also being studied. (auth)

18003 (EURAEC-198) STEAM SINTERING OF URANIUM DIOXIDE. Quarterly Progress Report No. 4, July 1, 1961 to September 30, 1961. (FIAT. Sezione Energia Nucleare, Turin). Oct. 31, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 011-60-9RDI. 18p. (FN-E-15)

Steam sintering experiments were successfully conducted. Argon gas was used both as the steam carrier and the cooling atmosphere. Preliminary results indicate that, at 1350°C the densification is nearly completed after 1 hour of soaking for pellets having a green density of 5 g/cm^3, but the fired density is comparatively low. The substitution of N in place of A is being tried, however first results are not encouraging. UO_2/U_3O_8 mixtures were prepared, heat treated, and are being x rayed. Preliminary results on the radial distribution of density in pellets were obtained. H sintered pellets of over-all low-density are less dense in the central part than in the outskirt. The same does not seem to hold true in the case of steam sintered pellets. (auth)

18004 (EURAEC-219) POSSIBILITIES OF THE APPLICATION OF THE ELECTRO-KEY WELDING METHOD. Quarterly Report Nos. 1-2, March to October 1961. Becken (Schweiss-technische Lehr- und Versuchanstalt, Duisburg, Germany). Oct. 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 046-61-3RDA. 4p.

Electro-key welding of steel is being investigated. Four welding wires of various compositons and special welding powder mixtures were used. The welding powder composition was found to have pronounced effects on the grain size of the seam. (M.C.G.)

18005 MICROMINIATURIZED FUEL ELEMENTS BY VAPOR-DEPOSITION TECHNIQUES. J. H. Oxley, M. F. Browning, N. D. Veigel, and J. M. Blocher, Jr. (Battelle Memorial Inst., Columbus, Ohio). Ind. Eng. Chem., Prod. Research and Develop., 1: 102-7(June 1962).

Methods used to prepare metallic or ceramic coatings on finely divided particulate fuels are discussed. Conversion data for the deposition of niobium coatings, rate data on the deposition of pyrolytic carbon, and preliminary information on chromium and oxide deposition are presented, as well as the results of a limited amount of evaluation work. (auth)

18006 HOT PRESSING OF POTASSIUM–SODIUM NIOBATES. R. E. Jaeger and L. Egerton (Bell Telephone Labs., Murray Hill, N. J.). J. Am. Ceram. Soc., 45: 209-13(May 1962).

Compositions in the system $KNbO_3$–$NaNbO_3$ were hot-pressed to yield ceramics with relative densities greater than 99%. Because these materials lack any degree of pyroplastic behavior, temperatures approaching those required for air sintering are needed. These hot-pressed specimens exhibit a finer microstructure than that obtainable by conventional processing. Enhanced piezoelectric coefficients are observed, and in certain compositional regions radial coupling coefficients were increased from 32 to approximately 48%. Dielectric constants increase with densification and a-c losses remain relatively high. The fine structure and improved piezoelectric activity, especially near the equimolar composition, make these materials desirable for electromechanical transducers, particularly in the 10 to 20 Mc range. The rate equation of Murray, Livey, and Williams for hot-pressing ceramics was found to apply in this system. (auth)

18007 METHOD OF COATING A BODY WITH TITANIUM AND RELATED METALS. Ross A. Quinn and Robert F. Karlak (to Lockheed Aircraft Corp.). U. S. Patent 3,022,201. Feb. 20, 1962.

A simple, inexpensive method for coating a ceramic body with Ti or one of the related metals Zr, Hf, and U is given which can be adapted to semi-automatic and mass production techniques. In the method, heat is supplied to a three-layer sandwich having one outer layer of Ti or a Ti alloy, the other outer layer of the ceramic substrate to be coated, and an inner layer of one or more of the alkali or alkaline earth metal halides. The inner layer serves as a barrier to oxidation. (D.L.C.)

18008 CORROSION RESISTANT COATING. Newell C. Cook (to General Electric Co.). U. S. Patent 3,024,175. Mar. 6, 1962.

A method is given for depositing a uniform, adherent, corrosion-resistant beryllide coating on a metal. The method comprises immersing the metal and Be in a fused bath of BF_3 and 10 to 67 mole % of an alkali metal fluoride and making an electrical connection between the metal and Be outside the bath to deposit Be on the metal. The metals

which may be beryllided in this way are those having atomic numbers of 21-29, 39-47, 57-79, and 89-98, and alloys having these metals as major constituents. Several examples of the method are given. (D.L.C.)

18009 CORROSION RESISTANT COATING. Newell C. Cook (to General Electric Co.). U. S. Patent 3,024,176. Mar. 6, 1962.

A method is given for depositing a uniform, adherent, corrosion-resistant boride coating on a metal. The method comprises immersing the metal and B in a fused bath of an alkali metal fluoride and 0.5 to 50 mole % of an alkali metal fluoroborate and making electrical connection between the metal and B outside the bath to deposit B on the metal. The metals which may be borided in this way are those having atomic numbers 23-29, 41-47, and 73-79, and alloys containing these metals as major constituents. Several examples of the method are given. (D.L.C.)

18010 CORROSION RESISTANT COATING. Newell C. Cook (to General Electric Co.). U. S. Patent 3,024,177. Mar. 6, 1962.

A method is given for depositing a uniform, adherent, corrosion-resistant silicide coating on a metal. The method comprises immersing the metal and Si in a fused bath of an alkali metal fluoride and 0.5 to 50 mole % of an alkali metal fluosilicate and making electrical connection between the metal and Si outside the bath to deposit Si on the metal. The metals which may be silicided in this way are those having atomic numbers of 23-29, 41-47, and 73-79, and alloys containing these metals as major constituents. Several examples of this method are given. (D.L.C.)

18011 PRODUCTION ON SINTERED COMPACTS OF BERYLLIA. Peter Murray and David Thomas Livey (to United Kingdom Atomic Energy Authority). U. S. Patent 3,025,137. Mar. 13, 1962.

A process is given for producing high-density beryllia compacts. The process comprises the steps of producing beryllia powder by calcining pure beryllium hydroxide at ~1250°C, cold-compacting the beryllia powder, heating the compact for 12 to 60 hr at 1250 to 1400°C to bring about welding of the particles, and heating gradually to a sintering temperature of ≥1500°C. (D.L.C.)

18012 METHOD AND MEANS FOR WELDING AND SOLDERING WITH THE HELP OF BEAMS OF CHARGED PARTICLES. Fritz Schleich and Karl Heinz Steigerwald (to Carl Zeiss). U. S. Patent 3,033,974. May 8, 1962.

A method and device for welding and soldering with an electron beam are described which subjects only a small region of the material adjacent to the weld to heat stress and which gives deep welds and relatively high welding speeds. The method comprises forming the electron beam into short pulses of 10^{-3} to 10^{-6} sec each, with relatively long rest intervals. (D.L.C.)

18013 USE OF A RARE EARTH METAL IN VAPORIZING METALS AND METAL OXIDES. Thaddaeus Kraus and Peter Rheinberger (to Balzers Patent- und Lizenz-Anstalt). U. S. Patent 3,034,924. May 15, 1962.

A method for producing thin oxide layers on bases is given which results in layers free from optical absorption in a relatively short time. The method comprises placing the body to be coated in a chamber, evacuating the chamber, heating in the chamber one of the group Th, Ti, Cu, Sn, Cr, Mg, Fe, Ni, and Co, or an oxide thereof, simultaneously heating in the chamber a rare earth metal-containing substance, and introducing an oxidizing gas at very low pressure to coat the body. Preferably, Pr is added to the first substance, and Ce is the rare earth metal. The advantage of this method is that no after-oxidation is required. (D.L.C.)

Properties and Structure

18014 (AD-263880) MECHANICAL PROPERTIES OF NIOBIUM. I. ELECTRON-BEAM MELTING AND ANALYTICAL METHODS. Status Report on Investigations, November 1, 1959–December 31, 1960. Hallstein Kjoellesdal, Torleif Lindtveit, and Kjell Boye (Sentralinstitutt for Industriell Forskning, Blindern, Norway). May 1961. (SI-publ.-324)

An apparatus for melting and purification of metals by electron bombardment was constructed. The equipment to be used for the high temperature tensile and creep tests is described. A method for electrolytic polishing of Nb was developed. The impurity content of tantalum and tungsten in the niobium specimens was measured by neutron activation analysis. (auth)

18015 (AD-263881) MECHANICAL PROPERTIES OF NIOBIUM. II. PREPARATION OF SINGLE CRYSTALS. Status Report No. 1, January 1, 1961 through June 30, 1961. Hallstein Kjoellesdal, Torleif Lindtveit, Paul Storvik, and Kjell Boeye (Sentralinstitutt for Industriell Forskning, Blindern, Norway). July 1961. 63p. (SI-publ.-325).

The electron bombardment, zone refining apparatus previously constructed was improved and investigations on the refining efficiency in removing the tungsten and tantalum impurities from niobium were carried out. A literature survey was also made. (auth)

18016 (AD-265129) INVESTIGATION OF MOLYBDENUM- AND TUNGSTEN-BASE ALLOY SHEET MATERIALS. Quarterly Report No. 1, May 24, 1961 to August 24, 1961. Gordon D. McArdle, Robert Q. Barr, and M. Semchyshen (Climax Molybdenum Co. of Michigan, Detroit). Contract NOw 61-0581-d. 17p.

Six vacuum-arc-cast, Mo- and W-base alloys were prepared. The selection of compositions for this program was based on promising alloys studied in the past in the form of rolled bar stock. Five of the alloys have been extruded to rectangular sheet bars. Additional extrusion, as well as the rolling of existing extruded bars, will be carried out. (auth)

18017 (AD-266019) OPTIMIZATION OF THERMOELECTRIC ENERGY CONVERTERS. Final Report, March 14, 1960–July 15, 1961. Ludwig Luft, ed. (General Electric Co. Aircraft Accessory Turbine Dept., Lynn, Mass.; General Electric Co. Electronics Lab., Syracuse, N. Y.; and General Electric Co. General Engineering Lab., Schenectady, N. Y.). July 31, 1961. Contract NObs 78402. 171p.

Thermal system analyses of typical water-cooled thermoelectric generators were made to establish optimized system performances and to determine the significance of changes in the properties of thermoelectric materials and other parameters. In the area of improving the utilization of thermoelectric materials, advances were made in increasing the temperature limits of encapsulation systems. Lead telluride was successfully encapsulated and 500-hour live tests at 600°C (T_h) confirmed the merits of encapsulation. Three classes of materials were studied, covering both the theoretical and the practical problems involved in reaching the goal of better thermoelectric substances. (auth)

18018 (AD-266937) MATERIALS PROPERTY DATA. Phase I, Quarterly Progress Report No. 1, April 1, 1961–

June 30, 1961. Norris A. Hooton (Bendix Corp. Bendix Products Div., South Bend, Ind.). July 1961. Contract AF33(616)-8086. 66p.

Results are presented of initial work conducted under a program to review and compile previously unreported materials property data. The data are to be taken from material research and development programs conducted by the Ceramic Engineering Department, Bendix Products Division, South Bend, Indiana. The data were obtained in tests of materials for high temperature erosion resistance. All materials were tested on an oxy-kerosene jet piercing torch. (auth)

18019 (AEDC-TDR-62-19) OUTGASSING CHARACTERISTICS OF VARIOUS MATERIALS IN AN ULTRAHIGH VACUUM ENVIRONMENT. D. K. Das (National Research Corp., Cambridge, Mass.). Jan. 1962. Contract AF40(600)-923. 119p.

The purpose of the program was to study the outgassing characteristics of a number of selected materials (Al, stainless steel, and carbon steel) to gain a better understanding of the origin of the gas evolution and at the same time to collect sufficient engineering data to permit an intelligent selection of materials, suitable designs, and modes of operation for large ultrahigh vacuum space simulation chambers. Bell jars were constructed of the above mentioned materials, and outgassing experiments were conducted. The highest amount of total outgassing was from the mild steel and the lowest from the stainless. The Al alloy outgassed but little more than did the stainless steel. The mild steel outgassed copiously at the initial pump down and at bakeouts, however subsequent outgassing rates at room temperatures were extremely low. (auth)

18020 (AFOSR-2230) ELECTRICAL PROPERTIES OF OXIDES OF SOME LANTHANIDE RARE EARTH ELEMENTS. Final Report. Clement J. Kevane (Arizona State Univ., Tempe). Feb. 28, 1962. Contract AF49(638)-789. 42p.

Electrical conduction was studied in ceramic CeO_2 and PrO_2 from room temperature to near 600°C. Measurements were primarily two-contact d-c type although some two-contact a-c measurements were made on CeO_2. Some electrical conductivity effects of departures from stoichiometry were studied in PrO_2 and CeO_2 using a quartz-beam microbalance. At 400 to 600°C the current which flows between Pt electrodes through CeO_2 at constant applied potential showed a decreasing transient. As the temperature was raised above 600°C, the low-bias transients became increasing transients and at intermediate biases the transients disappeared. The a-c resistance and capacitance of a CeO_2 ceramic pellet with Pt electrodes were strongly frequency dependent. The a-c sample resistance decreased with frequency as did the capacitance. At low frequency the capacitance became very large and if this capacitance were considered to be a bulk material effect it would correspond to a very large dielectric coefficient at frequencies near 100 cps. Sintered ceramic pellets of CeO_2 containing one percent CaO appeared to exhibit ionic conduction and electrolysis under the action of an applied d-c potential. All of these effects combine to form evidence for some degree of ionic conduction in CeO_2 below 600°C. (auth)

18021 (ARF-2182-B1-27) DUCTILE HIGH-TEMPERATURE TUNGSTEN ALLOYS. Quarterly Report, July 1, 1961–September 30, 1961. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 27, 1961. Contract DA-11-022-505-ORD-3092. 8p. (AD-265620)

A program for development of a high-temperature, liquid-phase sintered W alloy is being pursued. Th proved to be the most acceptable matrix base; initial results indicate that W–Th alloys are capable of room-temperature deformation and workability, possess good high-temperature strength, and have a melting point in excess of 2000°C. Effort is concentrated on reducing or eliminating porosity to improve room-temperature fabricability. The decomposition of thorium hydride during sintering resulted in less porosity. A W–15Th alloy was initially found to have compressive ductility equivalent to W–20Th. The elevated temperature workability characteristics of these compositions were initially determined; at 1000°C, W–Th can be severely rolled or hammer-forged without occurrence of cracking. (auth)

18022 (BM-IC-8084) BIBLIOGRAPHY ON ZIRCONIUM: SUPPLEMENT TO INFORMATION CIRCULARS 7771 AND 7830. Eleanor Abshire (Bureau of Mines, Albany, Ore.). July 1961. 99p.

References with abstracts are presented for 780 literature references and 107 U. S. and foreign patents pertinent to recent literature on zirconium and developments in the metallurgy of zirconium. (C.H.)

18023 (CVNA-127) THERMAL CONTACT CONDUCTANCE BETWEEN UO_2 AND ZIRCALOY 2. R. A. Dean (Westinghouse Electric Co. Atomic Power Div., Pittsburgh). May 1962. For Carolinas Virginia Nuclear Power Associates, Inc., Charlotte, N. C.). Contract [AT (30-1)-2289]. 41p.

Tests are described which were undertaken to determine the conductance between UO_2 and Zircaloy-2. The tests were conducted in an argon atmosphere in the CVTR to obtain data on conductance modes, and the effects of contact pressure and surface finish on these modes. The conductance through a gas gap was found to be inversely proportional to the gap width, while the contact conductance is inversely proportional to the square root of the surface profiles wavelength products. (J.R.D.)

18024 (DMIC-167) SUMMARY OF THE FIFTH MEETING OF THE REFRACTORY COMPOSITES WORKING GROUP. W. D. Klopp (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Mar. 12, 1962. Contract AF 33(616)-7747. 74p. (PB-151088)

A brief summary of the reports presented at the Fifth Meeting of the Refractory Composites Working Group is given. Subjects covered include protective coatings, heat-resistant ceramic composites, dispersion strengthening, plasma spraying, and high-temperature reactions. (auth)

18025 (EURAEC-6) IMPROVING THE SINTERING OF URANIUM OXIDE WITH A VIEW TO INCREASING ITS HEAT CONDUCTIVITY. Quarterly Report No. 2, June 29 to September 14, 1960. (Compagnie Générale de Télégraphie sans Fil, Paris). Work performed under United States–Euratom Joint Research and Development Program. Contract 004-60-3RDF. 8p.

Activities during the period were mainly devoted to preparation of sintered UO_2 samples with and without additives. Procedures and apparatus for physical measurements of the sintered samples are described. (J.R.D.)

18026 (EURAEC-78) SWELLING OF URANIUM. Quarterly Report No. 2, January 1–March 31, 1961. (Brussels. Centre d'Étude de l'Énergie Nucléaire). Mar. 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract [022-60-10RDB]. 35p.

A description is presented of methods used in attempts

to obtain thin U foils with high-purity, large-grain size, and smooth surfaces. In other work thin foils of Pt were prepared and studied before and after neutron irradiation. Further studies of the formation, growth, and annealing of defects in Pt are planned. Results of electron microscopic studies are included on quenched and irradiated Nb foils. Impurities in Nb were found to precipitate after thermal treatment and irradiation. (J.R.D.)

18027 (EURAEC-186) SWELLING OF URANIUM. Quarterly Report No. 4, July–September 1961. (Brussels. Centre d'Étude de l'Énergie Nucléaire). Sept. 1961. Work performed under United States–Euratom Joint Research and Development Program. 22p.

A study of very thin U and Pt foils by transmission electron microscopy is described. A method of preparation of very thin α–U foils is reported. Such foils contain large grains and their surface is slightly passivated by the final electrochemical thinning. The latter prevents them from stronger oxidation and allows to observe their substructure in the microscope. Some photographs of the substructure are shown. Further studies were conducted on thin beaten Pt foils, subsequently quenched and/or irradiated. In the quenched foils features are observed that are thought to be spherical voids caused by quenching. The features are rather stable to thermal treatment. Some of the voids transform in dislocation loops or disappear completely during the annealing. The origin of the features and their stability are discussed. Quenched and irradiated foils present preferential formation of defect clusters and loops in the central part of the grain. Boundary zones are sometimes denuded. From these observations it is suggested that the clusters and loops are associated with vacancies rather than with interstitial atoms produced by irradiation. (auth)

18028 (EURAEC-197) FISSION GAS RELEASE FROM URANIUM DIOXIDE. Quarterly Progress Report No. 3, July 1, 1961 to September 30, 1961. (FIAT. Sezione Energia Nucleare, Turin). Oct. 31, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 021-60-9-RDI. 23p. (FN-E-14)

The preparation and selection of irradiation samples are going on steadily. The natural UO_2 samples were selected and their characterization was completed with the exception of surface area determination by means of Kr adsorption technique which is in progress. Pelletizing of UO_2 powder was initiated. The temperature attained in the core of the natural UO_2 standard pellet during irradiation was measured by means of an instrumented capsule. Maximum temperature (approx. 80°C) is such that fission gas thermal diffusion during irradiation will be negligible. Two reactivity tests were performed by placing and extracting the irradiation container in the core with 6 and 26 standard capsules respectively. The hot cell was assembled in the shop, disassembled and is being assembled again at the place where it will be operated. A set of 6 pellets were introduced into the reactor. These pellets will be used for the first hot manipulations in the cell. Preliminary fission gas release experiments with UO_2 small samples were performed up to 1100°C. A brief literature survey of recent fission gas release experiments with comments on their connections with the current program is also included. (auth)

18029 (EURAEC-225) THE DEVELOPMENT OF A NEW DETERMINATION OF THE DUCTILE-BRITTLE TRANSITION TEMPERATURE. Quarterly Report No. 1, November 1 to December 31, 1961. C. A. Verbraak (Netherlands. Nijverheidsorganisatie, TNO, The Hague). Work performed under United States–Euratom Joint Research and Development Program. Contract 068-61-11RDN. 6p.

Experimental set ups were constructed, and various methods for measuring fracture velocity and determining shock waves were tested. The light intensity of the flash for the rotating mirror camera was improved, and is now sufficient for recording a fracture in a Robertson test. The capacity, magnetic, and strain-gage methods for the measurement of shock waves were tested with elastic waves. (auth)

18030 (FXM-743) PHYSICAL PROPERTIES OF SOME FLUORIDES (REVISED). M. S. Freed ([Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.]). May 24, 1954. Contract [AT(11-1)-229]. 6p.

Physical properties of fluorides studied at Oak Ridge National Laboratories are listed in tables and figures. The data are a revision of FXM-426, Physical Properties of Some Fluorides, and where it differs from that memorandum it is felt that the later data are more nearly correct. (auth)

18031 (GAMD-1172) ANALYSIS OF STRESSES IN THE CENTRAL PORTION OF MONEL-CLAD FUEL ELEMENTS DURING THERMAL CYCLING. G. Donaldson (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Dec. 18, 1959. Reprinted Mar. 29, 1962. Contract AT(04-3)-314. 23p.

Stresses arising from the thermal cycling of monel-clad fuel elements were investigated near the center of the cladding. Calculations were based on a graphite sleeve of 3.50-in. OD and 2.50-in. ID, surrounded by monel cladding of 0.010 or 0.016-in. thicknesses. In all cases, the cladding was assumed to be stressed to the yield point (0.2% offset) in tension at the start of thermal cycling. During cycling, the sleeve and cladding were heated from 70 to 1500°F and held at the latter temperature until all stresses were annealed out. The cycle was then completed by cooling to 70°F once more. Uniform temperatures were assumed in the cladding and sleeve to simplify calculations. During thermal cycling, zero pressure within the graphite sleeve and an external pressure of 300 psi were assumed. Calculations for the initial shrink fitting of the cladding were made at 300 psi and also at atmospheric pressure. One calculation was made at a representative heating rate of 358°F/hour to estimate the effect of creep at elevated temperatures. One of the calculated stress curves was then corrected to allow for creep. Calculations were made by combining the relations for elastic strains in thick wall and thin wall cylinders. Suitable corrections were applied for calculations above the elastic limit. Data on the mechanical properties of monel were extrapolated as necessary to complete the calculations. For this reason, the lack of reliable and consistent data on monel is considered the major weakness of the study. (auth)

18032 (GCM/UK/27) THE PORE STRUCTURE OF PILE GRAPHITE GRADE 'A'. R. L. Bond and D. H. T. Spencer (British Coal Utilisation Research Assn., Leatherhead, Surrey, England). [nd]. Contract A/CON/2450. 62p.

Presented at Libby-Cockcroft Meeting on Gas Coolant Compatibility, Harwell, Berks, England, April 1962.

The results of a study of one unit block of Pile Graphite Grade 'A' are reported. The open porosity is high ~19%, most of which is located beyond entrances with diameters in the range 0.1 to 58μ. Many of these entrances lead to pores appreciably wider than themselves and some 80% of

the open porosity appears to be located in macro-pores with diameters >10μ. This macro-structure, however, accounts for only a small part (5%) of the accessible surface area (~0.2 m^2/g); on the other hand there is little or no internal surface or volume associated with open pores having diameters of molecular size. The material possesses an appreciable porosity (~4%) closed to helium; the surface area of these closed pores, some of which must be very fine, is relatively high, more than 4 m^2/g. The lump density varies across the cross section of the block, falling towards the center, and also it varies along the extrusion direction. A summary of the results is included. (auth)

18033 (GEMP-10A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 10, PART A. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 16, 1962. Contract AT(40-1)-2847. 29p.

Results are presented obtained in a study to define the physical and mechanical properties of irradiated BeO. Parameters such as purity, additives, grain size, density, and porosity are considered at various irradiation temperatures and dosages. During the period, work continued on the composition and the grain size-density series. The irradiations of the composition series were completed, and the initial irradiation assemblies of the grain size-density series were prepared. Property measurements continued on specimens of both series. Measurements on specimens of several grain sizes and densities provided evidence of preferred orientation effects of crystals on the properties of sintered specimens before, as well as after irradiation. Elastic constants, in particular, are affected by preferred orientation; indications are that modulus of rupture and creep are also affected. Specimens of preferred orientation exhibited somewhat greater radiation stability than those of random orientation. Observations on the specimens irradiated for two Engineering Test Reactor (ETR) cycles indicated that the limiting exposure in 100°C irradiations is in the range of 6 to 8×10^{20} neutrons/cm^2 (≧ 1 Mev). At this dosage the specimens were intact but too fragile for completion of density and dimensional measurements. The modulus of rupture after a dosage of 4×10^{20} neutrons/cm^2 at 100°C was of the order of 1000 psi. (auth)

18034 (HW-73398) STRENGTH AND METALLURGICAL PROPERTIES OF THE ZIRCALOY-2 PRESSURE TUBES FOR THE PRTR. R. L. Knecht and P. J. Pankaskie (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1962. Contract AT(45-1)-1350. 24p.

The ultimate hoop strength of the annealed portion of the PRTR Zircaloy-2 pressure tubes was determined by hydrostatic burst tests wherein the tube test specimens were internally pressurized to failure at temperatures from 425 to 750°F. In these tests, biaxial stresses simulating reactor operating conditions are imposed so that the circumferential stress is approximately twice the axial stress. The ultimate strength of the PRTR tubes thus tested is about 40 to 50% greater than the ultimate strength of rolled and annealed Zircaloy-2 strip determined from tensile tests. Extrapolation of long term (circa 5000 hours) tensile creep tests on longitudinal specimens cut from the annealed portion of the PRTR tubes showed that a stress of about 20000 psi will produce about 1% total deformation in ten years (the service limit used in the design of PRTR tubes) whereas for rolled strip Zircaloy-2 a stress of about 15000 psi would produce about 1% strain in ten years. These data further show that in tensile creep tests about 90% of the total creep deformation occurs during the primary creep stage. Very short term (circa 100 hours) pressure creep tests suggest that, under biaxial stress conditions (circumferential stress equal to twice the axial stress) the primary creep deformation is much less than was anticipated from an analysis of the uniaxial tests. Using the annealed ultimate strength, determined from hydrostatic burst tests and the PRTR operating conditions (1050 psig at 550°F), the safety factor is nearly 3.5 compared to a safety factor of 2.5 based on the ultimate strength of annealed Zircaloy-2 strip; for PRTR scram type trip limits (1160 psig at 550°F) the safety factors are respectively about 3 and 2. (auth)

18035 (HW-SA-2531) AN ANALYSIS OF A CYLINDRICAL GRAPHITE TUBE SUBJECTED TO DIAMETRAL COMPRESSION (thesis). Francis John Kempf (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 11, 1962. Contract [AT(45-1)-1350]. 66p.

Installation of a segmented graphite sleeve column was proposed as a method of alleviating a control rod operational problem in a nuclear reactor. Diametral compression strength and deflection characteristics of each sixteen inch long segment of sleeve column were required to evaluate the adequacy of the proposed sleeve. These data also establish minimum requirements of alternate sleeve configurations in the event that the proposed sleeves fail during a one channel trial installation. The value of diametral compression load at which the sleeve segment ruptures was determined at room temperature for six inch, ten inch, and fourteen inch lengths of load application. The load at failure is shown to be a linear function of load application length in the range tested. Data obtained from destructive tests of twenty-one typical sleeve segments were utilized to determine rupture factors for the sleeves under consideration. These rupture factors can be used to determine, within 20%, the ultimate strength of like sleeves of the same material in diametral compression. Uniform axial loading below 300 pounds, applied simultaneously with the diametral load does not effect the diametral compression strength of the sleeve. Vertical deflection of the graphite sleeve under diametral load was determined to be a linear function of the total applied load and in the range investigated, was found to be essentially independent of the length of load application. When average values of Young's modulus and the theory of inextensional deformation were used, vertical deflection calculations failed to predict the graphite sleeve deflection. The measured values of deflection were determined to be about a factor of three greater than the calculated values. This discrepancy can be attributed to uncertainties in the value of Young's modulus for the grade and form of the graphite specimens tested. (auth)

18036 (NP-11457) RÖNTGENOGRAPHISCHE UNTERSUCHUNG DER KRISTALLSTRUKTUR DES ZIRKONTRISELENIDS $ZrSe_3$ (DISSERTATION). (X Ray Study of the Crystal Structure of Zirconium Triselenide ($ZrSe_3$) (thesis)). Wolfgang Kroenert (Berlin. Technische Universität). 1961. 78p.

By use of x-ray photographic methods, the crystal structure of $ZrSe_3$ was investigated. The monoclinic elementary cell contains two formula units of $ZrSe_3$ which yield an x-ray photographic density of 5.70 g/cm^3 compared with an experimental value of 5.62 g/cm^3. For determination of the atomic coordinates, the reflection intensities of the two zones were measured. Characteristic of the $ZrSe_3$ structure is the presence of a layer lattice with pronounced asymmetrical coordination of the Se atom. A part of the

Se atom is bound to the Se_2 couple. The important distances are Zr–Se = 2.73 Å and Se–Se (couple) = 2.35 Å. (M.C.G.)

18037 (NP-11502) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Frazier, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Mar. 1962. Contract AF33(616)-7747. 55p.

A bibliography of selected accessions is present on high-strength alloys, light metals, nonmetallics, refractory metals, and various coatings, applications, and composites. (J.R.D.)

18038 (NYO-9046) DIFFUSION OF FISSION GASES THROUGH URANIUM OXIDE AND URANIUM CARBIDE. Semi-Annual Progress Report, December 1959–June 1960. J. J. Weinstock and A. P. Pinkerton (Radiation Applications Inc., Long Island City, N. Y.). Aug. 11, 1960. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2497. 17p. (EURAEC-67)

A study was begun of the diffusion rates of krypton and xenon into unirradiated UO_2 and UC at temperatures between 1000 and 2500°C. Exposure of UO_2 and UC samples to a Kr^{85} atmosphere at various temperatures, removal of surface-adsorbed krypton, dissolution of the sample, collection and ion chamber measurement of the diffused Kr, and calculation of diffusion coefficients from these data are described. The method of calculation is presented along with a discussion of previous work on this subject. (auth)

18039 (TID-14769) CALORIMETRIC, STRUCTURAL AND MAGNETIC STUDIES OF METALS AND INTERMETALLIC COMPOUNDS. Annual Report, February 1, 1961 to February 1, 1962. R. S. Craig (Pittsburgh. Univ.). Feb. 1, 1962. Contract AT(30-1)-2163. 67p.

Progress is reported on studies of solid solutions of lanthanides, laves phases in transition metal systems, magnetic susceptibilities of NiAl alloys, and heat capacities in the liquid helium temperature region. The studies were undertaken to understand the physico-chemical behavior of solids, forces acting between particles in solids, relations between structures of binary systems and their energetics, and the effects of atomic properties on physical properties of alloys. (B.O.G.)

18040 (TID-15209) ACTIVATION QUANTITIES FOR THE CREEP OF SODIUM AND LITHIUM (thesis). Report No. 7. Rodney Harry Cornish (Cornell Univ., Ithaca, N. Y.). Sept. 1961. Contract AT(30-1)-2504. 131p.

An equation of state for steady-state creep is proposed in the form $\epsilon = f[\sigma, s, t \exp(-F_{cr}/RT)]$ where f = state function, F_{cr} = free energy of activation for creep = $E_{cr} + pV_{cr} - TS_{cr}$, E_{cr} = energy of activation for creep, V_{cr} = volume of activation for creep, S_{cr} = entropy of activation for creep, p = absolute pressure, and s = structure dependent variable. The effects of high hydrostatic pressure on creep in sodium and lithium were measured. Development of high-pressure hardware, measurement techniques, the data acquisition system, and experimental procedures are discussed. Results are presented in graph and table form. (M.C.G.)

18041 (TID-15482) A STUDY OF GAMMA-RAY PHOTOCONDUCTIVITY IN ORGANIC DIELECTRIC MATERIALS (thesis). S. E. Harrison (Sandia Corp., Albuquerque, N. Mex.). 1962. Contract [AT(29-1)-789]. 71p. (SCDC-2580)

The gamma-ray photoconductivities of polyethylene, polystyrene, polyvinylchloride, polypropylene, Teflon, nylon, Kel-F, and three thermosetting resins denoted as Epoxy 1478-1, 1478-3, and 1478-22 were measured. The measurements were made at steady-state gamma-ray intensities ranging from 1.0 rad (H_2O)/min to 3.0×10^5 rads (H_2O)/min and at controlled temperatures ranging from 90 to 140°F. Conductivity changes resulting from the steady-state gamma-ray exposures were measured continuously throughout the exposure and after the exposure. The conductivity was found to exhibit distinct features in three time intervals: interval 1 is where photoconductivity is responding to a step increase in radiation intensity; interval 2 is where the photoconductivity has reached an equilibrium value whose magnitude is defined by radiation intensity and temperature; and interval 3 is where the conductivity is recovering upon sample removal from the gamma-ray environment. The time required during interval 1 for the conductivity to reach the equilibrium value of interval 2 is defined as the rise time (τ_r) and was experimentally found to decrease with increased irradiation intensity according to the relationship $\tau_r = \tau_r' \dot{R}^{-\mu}$. The equilibrium conductivity values of interval 2 give a dependence of photoconductivity on irradiation intensity at a given temperature which is characterized to good approximation in one or more regions, within which conductivity (σ) is expressed as $\sigma = \sigma_0' \dot{R}^{\delta}$. Experimental values of δ range from 0.00 to 2.72. Conductivity decays with time (t) from an equilibrium value (σ_{eq}) after abruptly stopping radiation exposure. The photoconductivity decay is characterized to good approximation by $\sigma(t) = \sigma_{eq}[Ae^{-t/\tau_1} + Be^{-t/\tau_2}]$ where τ_1 and τ_2 are two distinct decay constants. Conductivity was observed to vary with temperature under both dark and radiation-induced conductivity conditions according to the relationship $\sigma = \sigma_0 e^{-E/kT}$. The thermal activation energy (E) is lowered by irradiation except for Epoxy 1478-1 which has one intensity interval, within which E is unchanged. (auth)

18042 (UNC-1000) CHARACTERIZATION OF UO_2 POWDERS. Fourth Quarterly Report, July 10, 1961–October 10, 1961. James F. Carpenter, Carl W. Kuhlman, and Robert A. Nelson (United Nuclear Corp., Chemicals Div., Hematite, Mo.). Jan. 20, 1962. Contract AT(40-1)-2699. 16p.

Studies are described of UO_2 powders to determine the relation between properties of the powders and sinterability. The main effort during the period was devoted to correlation of the powder particle size distribution with the sintered density of pellets. The pressure applied during the green forming step of pellet production is shown to have a varied and considerable effect on ceramic particle size distribution in the pellets. (J.R.D.)

18043 (WADD-TR-60-266) HIGH TEMPERATURE PROPERTIES OF SEMICONDUCTORS. B. Abeles, D. Beers, G. Cody, R. Novak, and F. Rosi (Radio Corp. of America. RCA Labs., Princeton, N. J.). May 1960. Contract AF33(616)-6165. 57p. (AD-246620)

Measurements were made of the thermoelectric properties of the system $Ga_xIn_{1-x}As$, both as a function of alloy composition and temperature. Results indicate that selected alloys in this system are most promising for thermoelectric power generation giving a figure of merit as high as 1×10^{-3} deg^{-1} for temperatures as high as 700°C. The diffusivity method of measuring thermal conductivities was developed to measure the thermal conductivity of semiconductors to an accuracy of ±2% at 1000°C. The apparatus was tested on Fe at 1025°C with an accuracy of ±2%. Comparably accurate diffusivity measurements on Ge were made at 800°C. The diffusivity method appears to be very satisfactory for determining high tem-

perature thermal conductivities, to a high accuracy independent of radiation losses. (auth)

18044 (WADD-TR-60-889) INVESTIGATION OF INTERMETALLIC COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS. Jonathan Booker, Robert M. Paine, and A. James Stonehouse (Brush Beryllium Co., Cleveland). Dec. 1960. Contract AF33(616)-6540. 143p. (AD-265625)

Intermetallic beryllides from the systems Ta–Be, W–Be, and Hf–Be along with the disilicides of W, Ta, and Mo, were screened for compounds capable of serving as structural materials at temperatures above 2500°F. The compounds studied were $TaBe_{12}$, Ta_2Be_{17}, Hf_2Be_{21}, $MoSi_2$, $TaSi_2$, and WSi_2. An investigation of the rates of oxidation of intermetallic beryllides was initiated. The oxidation of $TaBe_{12}$, Hf_2Be_{21}, $ZrBe_{13}$, and Ta_2Be_{17} at 2300 to 2750°F was found to obey an exponential rate law which was cubic or a higher power rate law. In most cases, the cubic rate law applied. The products of the oxidation of $ZrBe_{13}$ at 2500°F were identified as Zr_2Be_{17} and BeO. Tentative activation energies for a cubic rate process were calculated for $TaBe_{12}$ and Hf_2Be_{21}. (auth)

18045 (AEC-tr-5086) VARIATION OF SPECIFIC MASS OF URANIUM AFTER COLD-WORKING AND DURING ANNEALING. J. P. Mustelier. Translated by M. S. Feldman (Savannah River Lab., Aiken, S. C.) from Compt. rend., 246: 3347-50(1958). 2p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 12896.

18046 (AEC-tr-5104) TYPES OF DEFORMATION OF BERYLLIUM AT HIGH TEMPERATURE AND RECRYSTALLIZATION AFTER TWINNING. P. Bastien and P. Pointu. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from J. Nuclear Materials, 5: No. 1, 153-5(1962). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12143.

18047 (AERE-Trans-887) STUDY OF THE INITIAL PHASE OF OXIDATION OF NUCLEAR GRAPHITE IN AIR AT TEMPERATURES BETWEEN 420°C AND 650°C. E. Bauer, ed. PART I. HETEROGENEOUS DISTRIBUTION OF IMPURITIES IN NUCLEAR GRAPHITE. F. M. Lang, P. Magnier, S. May, and G. Pinte. PART II. KINETIC STUDY OF THE INITIAL PHASE OF OXIDATION OF NUCLEAR GRAPHITE IN AIR. F. M. Lang, S. Keraudy, C. Koch, and P. Magnier. Translated by H. M. Tomlinson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from J. chim. phys., 58: 47-60(1961). 26p.

Also issued in French as reprint CEA-1891.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 22772.

18048 CRYSTAL STRUCTURE INVESTIGATIONS ON THE Zr–Al AND Hf–Al SYSTEMS. Lars-Erik Edshammar (Univ. of Stockholm). Acta Chem. Scand., 16: 20-30(1962). (In English)

A review is given of phase analysis and structure studies on the Zr–Al and Hf–Al systems. The structures and properties of the phases are discussed and compared with those of some transition metal borides and silicides and other metal phases. The atomic parameters of Hf_2Al_3 were refined. (auth)

18049 TRACER DIFFUSION IN NIOBIUM AND MOLYBDENUM. R. F. Peart, D. Graham, and D. H. Tomlin (Univ. of Reading, Eng.). Acta Met., 10: 519-23(May 1962).

Experiments carried out as part of an investigation of diffusion in b.c.c. metals are described. The data are of technical interest in view of the importance of refractory metals, including niobium and molybdenum, in current engineering applications at high temperatures. Radioactive tracer methods were used and the temperature range was extended up to 2330°C. Details of the relevant techniques are described. The results of self diffusion measurements in niobium are in good agreement with a previous work, and in addition, tracer diffusion of Co^{60} and Fe^{55} in niobium was studied. In molybdenum, grain boundary diffusion was found to be a dominant feature, even at temperatures as high as 2000°C, but it was possible to measure the lattice diffusion of Co^{60} in Mo within individual grains. A previously reported work on the same problem is shown not to be representative of lattice diffusion. (auth)

18050 THE STATUS OF BERYLLIUM METAL IN NUCLEAR REACTORS. PART I. P. Loewenstein (Nuclear Metals, Inc., Concord, Mass.). Atompraxis, 8: 122-8(Apr. 1962). (In English)

The use of beryllium in power reactors is extremely attractive from an economic point of view. Almost all types of reactors now under consideration could use beryllium metal to advantage. The principal reasons beryllium is not used more widely are high cost, physical properties, irradiation properties, and toxic properties. All of these negative aspects of the metal are under active investigation, and the entire beryllium picture is in a state of flux, it is likely that many or all of the objectionable features will be reduced or eliminated. Solutions to the problems will be forthcoming within a matter of a few years, and the use of beryllium in reactors should increase considerably. (auth)

18051 THE EMISSIVITIES OF VARIOUS NIOBIUM SURFACES IN THE TEMPERATURE RANGE 500–1100°C. D. A. Howl and A. F. Davis (United Kingdom Atomic Energy Authority, Springfields Works, Preston, Lancs, Eng.). Brit. J. Appl. Phys., 13: 223-6(May 1962).

The total hemispherical emissivities of various niobium surfaces were determined in the temperature range 500 to 1100°C with accuracy to 5% or better. The specimens were in the form of tubes, and the five surfaces were in the as-manufactured condition, deoxidized, and three types with varying degrees of nitriding. During the investigation, it was found that the emissivities altered with heat treatment. Sets of results are therefore given for both the initial and final conditions, the latter being the state reached when no further change could be detected. (auth)

18052 CRYSTALLOGRAPHIC DATA, URANIUM DIBORIDE. John L. Lunsford, R. Jay Fries, and Charles P. Kempter (Los Alamos Scientific Lab., N. Mex.). Crystal Front, 2: No. 1, 13-14(June 1961).

A small quantity of UB_2 was prepared by mixing weighed amounts of the two reactants in a dry box, briquetting the mixture in air, and then arc melting the briquette in argon into a button. A piece of the button was examined metallographically and found to contain a single phase with a microhardness (DPH) of 1000 kg per mm^2 with a 100-g load. The lattice parameters obtained were $a_0 = 3.1319 \pm 0.0001$ and $c_0 = 3.9858 \pm 0.001$ Å ($c_0/a_0 = 1.273$). Correcting for refraction, the parameters became $a_0 = 3.1320$ and $c_0 = 3.9860$ Å with the same axial ratio. For 1(UB_2) per unit cell, the theoretical density is 12.73 g/cc at 25°C. For the AlB_2 structure type (D^1_{6h}-P6/mmm), the minimum U–U bond distance is 3.132, the B–B bond distance 1.808, and the U–B bond distance is 2.691 Å. The separation distance of the U or B atomic sheets is 3.986 Å. (P.C.H.)

18053 A STUDY OF ORDER IN THE ALLOY W + 44 AT. % Mo BY MEASURING THE DIFFUSION SCATTERING

OF X-RAYS. E. Ya. Ol'shanskaya, Yu. V. Nekrasov, and Ya. S. Umanskii. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 349-51(Mar. 1962). (In Russian)

Thin layers of a W–Mo alloy (absorption half-thickness = 0.25 μ) were irradiated with a well-collimated beam of CuK x rays in a vacuum diffractometer, and the scattered x rays were measured at room temperature over an angle of 8 to 20° on an argon counter. The external surface of the alloy sample was removed by etching in a hot melt of $NaNO_3$ + 40% NaOH for about 30 seconds. The instrument was calibrated by comparing the calculated and experimental values for the scattering intensity obtained from pure copper. The close order coefficients were calculated on the assumption that there is no dimensional effect, since the difference in atomic radii of W and Mo is small (0.7%), and since the lattice period of the solid solution varies linearly with concentration. The radial distribution of atom density was plotted from the formula: $f(r) = (2r^2/\pi)\Sigma_S S^2\varphi(S)(\sin Sr/Sr)\Delta S$. Experimental intensity curves for the diffusion scattering are given for samples tempered from 1100 and 1350°C, and a calculated curve for a sample tempered from 1700°C. The order parameters change only slightly with temperature. (TTT)

18054 THE BINARY SYSTEM Nb_2O_5–SiO_2. M. Ibrahim and Norman F. H. Bright (Dept. of Mines and Technical Surveys, Ottawa). J. Am. Ceram. Soc., 45: 221-2 (May 1962).

The binary system Nb_2O_5–SiO_2 is shown to include an extensive two-liquid region over the range 5 to 80% Nb_2O_5. The minimum temperature of the two-liquid area is 1695°C. A eutectic composition occurs at 95% Nb_2O_5 and 1448°C and another at approximately 5% Nb_2O_5 and 1695°C. The experimental results were obtained by the cone-fusion method. (auth)

18055 AN ELECTRON MICROSCOPE STUDY OF PYROLYTIC GRAPHITE. William J. Coy (Lockheed Missiles and Space Co., Sunnyvale, Calif.). J. Am. Ceram. Soc., 45: 223-5(May 1962).

An electron microscope study of pyrolytic graphite is presented in which subgrains of 0.1μ are shown. The effect of a cathodic vacuum etch on transverse and normal sections is given. Cracks in the structure are shown to be approximately 4μ long, parallel, and separated by 1μ. (auth)

18056 VERIFICATION OF EXISTENCE OF CUBIC ZIRCONIA AT HIGH TEMPERATURE. Deane K. Smith and Carl F. Cline (Univ. of California, Livermore). J. Am. Ceram. Soc., 45: 249-50(May 1962).

The existence of the high-temperature cubic form of ZrO_2 was verified with an x-ray diffractometer. The 200 and 002 doublet was taken as the best indicator of the phase change, and the transformation was found to occur at 2285 ± 15°C with first order kinetics. The structure was found to be face-centered cubic of the CaF_2 type, and the cell constant was measured as 5.272 A. (D.L.C.)

18057 CONCERNING THE PHASE DIAGRAM AND DIELECTRIC BEHAVIOR OF THE OXIDE SYSTEM Al_2O_3–Nb_2O_5. Egon K. Mueller and Basil J. Nicholson (Philco Corp., Blue Bell, Penna.). J. Am. Ceram. Soc., 45: 250-1(May 1962).

An x-ray analysis was performed on sintered pellets in the system Al_2O_3–Nb_2O_5 to obtain information about the intermediate phases in this system. The results indicate that $AlNbO_4$ is the only existing intermediate phase, with a melting point of 1550 ± 20°C. No evidence was found for the existence of $AlNb_3O_9$ as a separate phase or for a ferroelectric phase. The product of $AlNb_3$ oxidized at 900°C was found to be a two-phase material consisting of Nb_2O_5 and $AlNbO_4$. The lattice spacings and x-ray intensities of $AlNbO_4$ are tabulated. The dielectric constants of pellets of varying composition in this system were measured under a variety of conditions; it is concluded that $AlNbO_4$ has a low dielectric constant and that addition of more Nb_2O_5 raises the dielectric constant. (D.L.C.)

18058 THERMODYNAMIC PROPERTIES OF THE TANTALUM AND TUNGSTEN BORIDES. James M. Leitnaker (Los Alamos Scientific Lab., N. Mex.), Melvin G. Bowman, and Paul W. Gilles. J. Electrochem. Soc., 109: 441-3(May 1962).

Experiments involving high-vacuum heating of samples of the tantalum borides, or tantalum and ZrB_2, or tungsten and ZrB_2 are discussed. Identification of the resulting phases by x-ray diffraction procedures served to indicate what chemical reactions occurred and what products can exist together at the test temperature. The results were used to obtain limiting values for the heats of formation of the various phases. The limits on heats of formation based on −76.7 for ZrB_2 are: $Ta_{2.4}B$, $Ta_{1.6}B$, and TaB = −64.9 to −38.4, $\frac{1}{3}TaB_2$ = −51.7 to −22.7, and W_2B = −26.0 to −20 kcal/mole. The results indicate greater stability for the tantalum borides than were reported previously and have set bounding limits on the stability of lower borides of both tantalum and tungsten. (P.C.H.)

18059 FRACTURE IN REACTOR GRAPHITE. G. M. Jenkins (Berkeley Nuclear Labs., Gloucester, Eng.). J. Nuclear Materials, 5: 280-6(Apr. 1962). (In English)

A microstructural examination of reactor graphite is described. Thin plates of graphite bonded to a thick beam were subjected to a uniform strain field by bending the beam and simultaneously examined by a light microscope. From such an examination it was established that the characteristic striations in grist (calcined coke) particles are main lines of weakness while binder bridges are regions of high stress concentration. Such localized cracking appeared at stresses lower than those required for complete fracture. Further evidence of the presence of localized cracking was provided by the rapid decrease in the apparent modulus of the material in bulk (determined by a resonance frequency method) if specimens were prestressed to values approaching the fracture stress. (auth)

18060 EXPERIMENTAL STUDY OF THE RECRYSTALLIZATION OF BELGIAN URANIUM. H. Massaux (Centre d'Étude de l'Energie Nucléaire, Mol, Belgium). J. Nuclear Materials, 5: 287-300(Apr. 1962). (In French)

With the aim of obtaining more complete knowledge of the properties of uranium, especially the grade of metal currently produced in Belgium, an experimental study of recrystallization after deformation and various heat treatments was undertaken. Diagrams were obtained defining the start and completion of recrystallization for strains in the range 5 to 320% and annealing temperatures in the range 425 to 525°C. Grain sizes were determined in fully recrystallized samples. (auth)

18061 LATTICE SPACING RELATIONSHIPS IN THE SYSTEM THORIUM–CERIUM–LANTHANUM. D. S. Evans and G. V. Raynor (Univ. of Birmingham, Eng.). J. Nuclear Materials, 5: 308-16(Apr. 1962). (In English)

Lattice spacings measured at 25°C are reported for the systems cerium–lanthanum, thorium–cerium, and thorium–cerium–lanthanum. In the cerium–lanthanum system, the spacings show a small positive deviation from a straight line drawn between the lattice spacings of the pure components. For thorium–cerium alloys, previous work which showed that cerium decreases the lattice spacing of thorium

in spite of its larger atomic diameter is confirmed, in contrast to the conclusion of van Vucht that cerium scarcely affects the spacing of thorium. The addition of lanthanum to thorium–cerium alloys progressively diminishes the initially large deviation of the lattice spacings from the straight line joining the lattice spacings of thorium and γ cerium; at 39 at. % lanthanum, the graph of lattice spacing against cerium content shows only a small deviation from additivity. The results are critically discussed, and provide support for the view that the chief reason for the adoption of a contracted form of cerium in the thorium-rich alloys, by the promotion of a 4f electron to the conduction band, lies in the substantial compressive forces which would be exerted by the thorium matrix on substitutionally dissolved cerium atoms corresponding to the normal 3-valent form. (auth)

18062 CRYSTAL STRUCTURES OF $ThRh_2$, ThRu AND ThIr. J. R. Thomson (Imperial Coll. of Science and Tech., London). Nature, 194: 465(May 5, 1962).

Brittle alloys were prepared and powdered for x-ray studies by crushing in air. Phase relations in thorium–rhodium alloys of 60 to 75 at. % rhodium are complex. The film of the compound at 65 at. % rhodium was indexed on the basis of a hexagonal lattice a = 4.629 ± 0.002, c = 5.849 ± 0.003, and c/a = 1.264. Systematic extinction of the OOO l and hh2hl reflexions were noted when l was odd and of hkil lines when h-k = 3n and l was odd. Observed intensities showed excellent agreement with those for the Ni_2In structure ($B8_2$) space group D^4_{6h} P $6_3/mmc$. ThRu and ThIr are formed directly from the melt. Their x-ray patterns were indexed as orthorhombic and their lattice parameters are given. No hkl reflections were observed unless h + k was even and hOl lines were present only when l was even. The lattice parameters and systematic extinctions suggested that ThRu and ThIr might be isostructural with ThCo space group D^{17}_{2h} Cmcm. (P.C.H.)

18063 NEW USES FOR THE RARE EARTHS. R. A Mintern (Johnson, Mathey and Co. Ltd., [Eng.]). New Scientist, 14: 225-7(May 3, 1962).

A general review of the physical properties of the rare earth metals and their general uses is given. Discussion is also given on nuclear uses, uses as the active atomic constituent of optical masers, and applications in electronics and thermoelectric devices. (P.C.H.)

18064 X-RAY DIFFRACTION LINE PROFILES OF ELECTROGRAPHITIZED CARBON PRODUCTS. Takiti Noda (Nagoya Univ., Japan), Michio Inagaki, and Chihiro Sugie. Nippon Kagaku Zasshi, 64: 2087-91(1961). (In Japanese)

The (001) diffraction line profiles of electrographitized carbon products were graphically separated into profiles of their component carbons. The products used for this experiment were made from a petroleum coke, a thermal black, or a furnace black and a binder pitch. The ratios of the integrated diffraction intensities of the component carbons were in good agreement with the mixing ratios of components, when the intensity of diffraction was corrected for the effect of preferrential orientation of graphite crystallities and for the weight loss in the process of graphitization. The lattice constant c_0 and size of graphite crystallities L_c of graphitized coke derived from the binder pitch in the carbon products were found to be 6.74 ~ 6.83Å and 280 ~ 130Å, respectively, while c_0 and L_c of coke derived from the same pitch without the admixture of carbon materials were 6.71 and 340Å, respectively. The degree of graphitization of coke from the binder pitch in the coke-base products was found to be larger than that of coke from the binder pitch in the carbon black-base products. (auth)

18065 SPECTROSCOPY AND LUMINESCENCE PROPERTIES OF CdF_2:Eu. J. D. Kingsley and J. S. Prener (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 126: 458-65(Apr. 15, 1962).

Characteristics relevant to the application of Eu^{+3}-activated CdF_2 to optical maser use are investigated. The line fluorescence is analyzed to obtain the positions of the lowest energy europium crystal states, and these are found to be consistent with the europium ion being in a crystal field having essentially tetragonal symmetry. The strongest emission line, at 5893.1Å, contains 1/3 of the total fluorescence and is due to a transition between states at 17278.6 and 309.7 cm^{-1}. At 15°K its width at half intensity is 0.32 cm^{-1}. It is found that the europium fluorescence can be sensitized by the addition of sulfide to the crystals. The total fluorescent quantum efficiency is determined to be 0.8 ± 0.2. The threshold power for oscillations in a rod of 0.1 cm^2 cross-sectional area is calculated to be 18 watts. (auth)

18066 FERROMAGNETISM IN EuH_3. R. L. Zanowick and W. E. Wallace (Univ. of Pittsburgh). Phys. Rev., 126: 537-9(Apr. 15, 1962).

Magnetic measurements are made on a Eu–H sample of composition $EuH_{1.86}$, from 4.2 to 300°K. The magnetization-temperature data for the sample indicate a Curie point at 24°K. Field dependency studies in the liquid helium range reveal saturation effects and remanence, confirming that $EuH_{1.86}$ is ferromagnetic at these temperatures. The observed saturation moment at 4.2°K is ~6.0μ_B (Bohr magnetons) per Eu atom. For T > 30°K the susceptibility shows a Curie-Weiss dependence on temperature and the effective moment is 8.4μ_B per Eu atom. EuH_2, the saturated hydride of Eu, exhibits magnetic ordering at low temperatures. As the hydrogen-saturated metals lack conduction electrons, the coupling between the localized 4f electrons is expected to be very weak and magnetic ordering is expected to occur only at very low temperatures if at all. Thus the behavior of $EuH_{1.86}$ is not in keeping with expectation. The coupling mechanism may be caused by direct overlap of the 4f orbitals. (auth)

18067 MAGNETIC STRUCTURE OF MANGANESE CHROMITE. J. M. Hastings and L. M. Corliss (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 126: 556-65(Apr. 15, 1962). (BNL-5802)

An investigation of the magnetic structure and properties of $MnCr_2O_4$ is carried out by means of neutron diffraction, and an evaluation of the suitability of various proposed theoretical models is made. From room-temperature diffraction patterns it is established that $MnCr_2O_4$ is a normal spinel with a u parameter of 0.3892 ± 0.0005 and with less than one percent of the Mn^{2+} ions present on B sites. The Curie temperature is ~43°K. Below this temperature the magnetic contribution to the fundamental spinel peaks arising from aligned spins increases as the temperature is lowered and is effectively saturated at about 20°K. At 18°K, additional sharp peaks appear at positions that cannot be indexed either on the original unit cell or on any reasonably enlarged cell. These extra reflections persist with unchanged intensities down to 4.2°K. No change in either the positions or intensities of the fundamental lines is observed in going through the transition. Above 18°K, a diffuse peak is present in the region where the principal extra lines develop. This diffuse peak decreases with increasing temperature, but is still observable above the Curie point. Application of a magnetic field along the neutron scattering vector decreases the magnetic contributions to the fundamentals, but increases the intensities of the extra reflections. It is concluded that the fer-

rimagnetic spiral model is a good first approximation to the ground-state spin configuration. (auth)

18068 STRESS RECRYSTALLIZATION OF GRAPHITE. L. C. F. Blackman and A. R. Ubbelohde (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), A266: 20-32(Feb. 27, 1962).

Conditions are recorded under which specimens of graphite deposited from pyrolysis of methane are found to incorporate large strain energy. Methods of relieving strains by annealing were investigated. Recrystallization under suitable constraint can be made to yield graphite of high crystal perfection. Observations indicate that such recrystallization is a co-operative process, which was termed stress-recrystallization. It is very rapid at 2700°C and can become uncontrollable. (auth)

18069 INVESTIGATION OF THE STRUCTURE AND DIELECTRIC PROPERTIES OF SOLID SOLUTIONS OF (Pb, Sr)(Ti, Zr)O_3. S. A. Fedulov and Yu. N. Venevtsev (Karpov Scientific Research Inst. of Physics and Chemistry, Moscow). Soviet Phys.-Solid State, 3: 2447-50 (May 1962).

The $PbTiO_3$–$SrZrO_3$ system forms a continuous series of solid solutions. The temperature dependence of the dielectric constant, conductivity, and loss tangent was investigated. A part of the phase diagram of the $PbTiO_3$–$SrZrO_3$ system at the $PbTiO_3$ end was constructed from x-ray data and dielectric measurements. (auth)

18070 BERYLLIUM FOR AEROSPACE STRUCTURES. L. A. Riedinger (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Space/Aeronautics, 36: No. 6, 64-7(Dec. 1961).

The results to date of a comphrensive evaluation of beryllium as an aero-space structure material are summarized in graphic form. The properties and performance of block and sheet beryllium are analyzed in tables and drawings. (N.W.R.)

18071 TEMPERATURE DEPENDENCE OF THE ISOTOPIC EFFECT EXPRESSED IN THE Li LATTICE PARAMETER. V. S. Kogan and V. I. Khotkevich (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 916-17(Mar. 1962). (In Russian)

A series of x ray pictures taken of Li isotopes at 20, 78, and 300°K shows a pronounced difference in the Li lattice parameter at low temperature. At T = 20°K, a (Li^6) = 3.480 Å and a (Li^7) = 3.478Å; at T = 78°K, a (Li^6) = 3.483 Å and a (Li^7) = 3.482 Å. (R.V.J.)

18072 THE PHASE DIAGRAM OF THE TANTALUM–NICKEL SYSTEM. I. I. Kornilov and E. N. Pylaeva. Zhur. Neorg. Khim., 7: 590-5(Mar. 1962). (In Russian)

Thermal, microstructural, and x-ray analyses were used to determine the complete phase diagram for the Ta–Ni binary system. The new compounds Ta_2Ni, TaNi and $TaNi_2$ were formed in Ta-rich alloys by a peritectic reaction at temperatures of 1785, 1570, and 1440°C. The results of the microstructural analysis agree with the data of the thermal analysis. The intermetallic compounds Ta_2Ni and TaNi show high values of the Vickers hardness of 847 and 627 units, respectively. These compounds are very brittle. The solubility of nickel in tantalum at 1600°C is about 6 at. %. It decreases to 0.48 at. % at 1300°C and stays constant with a further decrease in temperature to 800°C. (TTT)

18073 SEMITHERMAL SPATIAL DIAGRAM OF A TERNARY SOLID SOLUTION IN THE CHROME–TUNGSTEN–MOLYBDENUM SYSTEM. N. V. Grum-Grazhimailo and D. I. Prokof'ev. Zhur. Neorg. Khim., 7: 596-604(Mar. 1962). (In Russian)

The lattice parameters of any homogeneous ternary solid solution section in the Cr-W-Mo system were obtained from experimental curves. A diagram of composition versus lattice parameter for three sectional cuts were plotted on the basis of changes in lattice parameter of phases present in the alloys at 1600, 1300, and 1000°C. The first group of vertical cuts was determined for a constant amount of 10, 20, and 30% Mo in the alloy. The other two groups of cuts were taken for a constant content of 20, 20, and 50% Cr in the alloy, and for a constant content of 40, 50, and 60% W in the alloy. The direction of the conical section in the two-phase region ($\alpha_1 + \alpha_2$ solid solutions) for the separation of a ternary solid solution were determined for isothermal sections at 1100 and 1300°C. It is shown that there is a ternary critical point due to instability of the ternary solid solution above the critical temperature in the chromium-tungsten system. The spatial diagram is asymmetric in form due to a shift toward the high-melting metals of tungsten and molybdenum. (TTT)

18074 FUSION DIAGRAM OF BINARY SYSTEMS CONSISTING OF A ZIRCONIUM AND HAFNIUM HALIDE. L. A. Nisel'son. Zhur. Neorg. Khim., 7: 693-4(Mar. 1962). (In Russian)

Pure halides were prepared from Zr metal containing less than 0.05% Hf, and from Hf metal containing about 0.3% Zr. The melting temperatures were determined over the range of compositions for the systems $ZrCl_4$–$HfCl_4$, $ZrBr_4$–$HfBr_4$ and ZrI_4–HfI_4. These binary systems show unlimited solubility in the liquid and solid state, and the melting point line is a straight line, as would be expected from the closeness in radii of Zr and Hf. The melting point data for the pure halides agree well with the literature data. Melting point data are also given for the system ZrI_4–$ZrCl_4$ and $ZrBr_4$–$ZrCl_4$. A sharp minimum is observed at about 58 mol % $ZrCl_4$ and at 368°C in the ZrI_4–$ZrCl_4$ system. (TTT)

18075 THE PHASE DIAGRAM OF THE TITANIUM–GADOLINIUM SYSTEM. E. M. Savitskii and G. S. Burkhanov (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Zhur. Neorg. Khim., 7: 699-701(Mar. 1962). (In Russian)

Ti was fused with Gd in an arc furnace with a tungsten electrode in a purified helium atmosphere. The titanium alloys contained 0.5, 1.0, 1.5, 2, 3, 4, 5, 10, 20, 40, 60, 80, 80, and 99.7% gadolinium. Differential thermal analysis shows formation of a eutectic at 1120°C. The low-temperature modification of gadolinium is isomorphous with the low-temperature modification of titanium (hexagonal close packing). X-ray analysis showed that up to 800°C the phases consist of gadolinium in α-titanium, and of titanium in α-gadolinium. No intermetallic compounds are formed. The solubility of Gd in α-titanium is 1.0 wt % at 600°C and increases to 3.0 wt % at 850°C. The solubility of titanium in gadolinium is <0.3 wt %. An increase in hardness is observed for the solid solutions. The hardness is approximately additive in the two-phase region. The phase diagram of the Ti–Gd system is analogous to the phase diagrams of titanium with other rare earth metals. (TTT)

18076 THE PHASE DIAGRAM OF THE VANADIUM–CERIUM SYSTEM. E. M. Savitskii, V. V. Baron, and Yu. V. Efimov. Zhur. Neorg. Khim., 7: 701-3(Mar. 1962). (In Russian)

The alloys containing up to 50 wt % cerium were prepared in an arc furnace having a non-consumable tungsten electrode in a purified helium atmosphere. Microstructural analysis showed the appearance of a second layer rich in cerium at 0.2 to 0.3% Ce. The maximum solubility of

cerium in vanadium is 0.1%. The microhardness of pure vanadium increases from 150 to 165-170 kg/mm^2 on addition of 0.05 to 0.1% Ce. No intermediate phases are formed in the system. X-ray analyses of the 50% Ce alloy shows only line of vanadium and cerium. The lattice parameters of vanadium (a = 3.029 Å) do not change on fusion with cerium. The phase diagram for the V–Ce system is presented. (TTT)

18077 THE RELATIONSHIP BETWEEN THE HEAT STRENGTH AND THE KINETIC OXIDATION COEFFICIENTS OF CHROME AND CHROME–NICKEL STEELS. A. V. Shreider and G. L. Degtyareva (State Scientific Research Inst. in Machine Building, USSR). Zhur. Priklad. Khim., 35: 455-8 (Feb. 1962). (In Russian)

The high-temperature oxidation of a metal can be expressed by a parabolic relationship: $\Delta g^n = k_1\tau$ or by a logarithmic relationship: $\Delta g = k_2 \lg \tau + k_3$, where Δg is the change in weight as a result of corrosion and τ is the time. Fifteen high heat-strength alloys were oxidized in an atmosphere of air at 900°C in a tubular muffle furnace for periods of 100, 200, 300, 400, 500, 700, and 1000 hours. The loss in weight was determined by removing the oxidized layer by cathodic polarization in a melt of 60% NaOH + 40% Na_2CO_3 at 40 to 50 amps/dm^2 at a temperature of 350 to 400°C for 5 to 15 minutes. The alloys 1 Cr18Ni9T, Cr23Ni13, Cr25T, Cr18Ni11Si2A, Cr18Ni11Si2Mn3A, and Cr18Ni11Si2Mn2A showed a parabolic variation in oxidation with time. The alloys Cr23Ni18, Cr25Ni20Si2, Cr25A15, Cr20Ni14Si2, Cr25Ni16Mn7AP, Cr25Ni16Mn7Si2AP, Cr25Ni16Mn7Si3AP, and Cr23Ni13Si2A showed a logarithmic variation in oxidation with time. A content of 2% Si is optimal for high heat strength. A minimum content of 1% Mn in the austenitic chrome–nickel steels is detrimental to the heat strength of an alloy in an oxidizing atmosphere as compared to a content of 2 to 3% Mn in the alloy. Aluminum forms a protective film on the alloy. Thus, the loss in weight for the Cr25T alloy was 90 g/m^2 after 1000 hours, and it was only 20 g/m^2 for the Cr25Al5 alloy. The results show that the oxidation rates vary as a function of the type and amount of alloying ingredients. (TTT)

18078 CRYSTALLINE STRUCTURE OF THE COMPOUND Ta_2Ni. P. I. Kripyakevich and E. N. Pylaeva (L'vov State Univ. and Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Zhur. Strukt. Khim., 3: No. 1, 35-7 (Jan.-Feb. 1962). (In Russian)

An x-ray phase analysis was run on Ta–Ni alloys (33.3 to 92.68 at. % Ta) prepared by levitation melting in a helium atmosphere. The three compounds Ta_2Ni, TaNi, and $TaNi_2$ were observed. An x-ray powder analysis of the Ta_2Ni alloy (13.96 wt % Ni) showed a tetragonal body-centered structure with a = 6.216 ± 0.005 Å, c = 4.872 ± 0.004 Å and c/a = 0.784. The Ta_2Ni compound is assigned a structure of the $CuAl_2$ type. The calculated intensities and interplanar distances agree well with the experimental values. The volume of the elementary cell of Ta_2Ni (189.0 Å^3) is greater than the volume of Ta_2B (163.0 Å^3), but a little less than that of Ta_2Si (191.3 Å^3). (TTT)

18079 OXIDATION RESISTANT CHROMIUM ALLOY. James A. McGurty and John F. Collins (to General Electric Co.). U. S. Patent 3,015,559. Jan. 2, 1962.

The addition of 0.5 to 6.0 wt % of a rare earth metal to Cr gives alloys with superior oxidation resistance in air at >2000°F and which are not contaminated with nitrogen. The rare earth metal may be one of the group Ce, Pr, Nd, Sm, Gd, Dy, Ho, Er, Tm, Yb, and Lu. Buttons of each alloy were heated in air at 2300°F for 100 hr and their weight gains and nitrogen absorptions compared with those for Cr under identical conditions. (D.L.C.)

Radiation Effects

Refer also to abstracts 17577 and 18338.

18080 (EURAEC-123) FISSION GAS RELEASE FROM URANIUM DIOXIDE. Progress Report No. 2, April 1–June 30, 1961. (FIAT. Sezione Energia Nucleare, Turin). July 31, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 021-60-9RDI. 15p. (FN-E-11)

The UO_2 powder sample preparation was initiated and characterization of the selected pellets is in progress. A series of experiments was completed on the behavior of UO_2 pellets sintered at temperatures up to 800°C in the presence of potassium pyrosulfate. The frame of the hot cell was completed together with the stainless steel container. A full size mock-up of the hot experimental facility under construction at Saluggia was erected at FIAT laboratories. The irradiation container, manipulators and other accessories for samples irradiation were fabricated. (auth)

18081 (EURAEC-180) THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS. Third Quarterly Report, July 1 to September 30, 1961. E. Anderson, W. Bollmann, D. King, M. Malone, and J. Spreadborough (Battelle Memorial Inst. International Div., Geneva). Oct. 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 041-60-12-RDS. 53p.

Results of tensile tests are presented on Armco Fe at room temperature. Measurements of the lower yield stresses of samples of known grain size have enabled the calculation of values of the parameter k_y in the Petch equation, for different strain rates. k_y is thought to be a measure of the number of dislocations released by a source (or a measure of the unpinning stress); it was found that k_y was sensitive to strain rate and increased with strain rate–a 50% increase was found for a change in strain rate from 8.3×10^{-6} sec^{-1} to 2.1×10^{-2} sec^{-1}. The other results of the tensile tests are briefly discussed. A device for electrolytically thinning tensile specimens to foils suitable for examination by transmission electron microscopy was constructed and tested. A selection is presented of dislocation configurations, mostly tilt boundaries, observed in Armco Fe. Examples of what are thought to be condensed vacancy loops in quenched and cold-worked material are also shown. A method for mounting samples to be irradiated, and for monitoring the maximum temperatures reached during irradiation is described, together with progress toward a satisfactory encapsulation procedure. (auth)

18082 (FXM-412) IRRADIATION OF FUEL SANDWICH IN MTR. E. West and J. Lamarsh (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). May 8, 1953. Contract [AT(11-1)-229]. 10p.

The reduction of gamma radiation to tolerance levels in irradiated fuel sandwiches containing 0.5 g of UO_2 during removal from the MTR to a lead shipping coffin and subsequently during transit was studied. It was found that an 11-in. shipping coffin will reduce the gamma flux below the tolerance levels. Due to weight limitations, the additional lead should be on the inside of the coffin, cutting the inside diameter down to 4 in. instead of 6 in. An annular lead

ring, 8 in. thick and 16 in. wide, around the plug hole of the MTR reduces the flux below physical tolerance at a point 3 ft from both the surface of the coffin and the reactor. (M.C.G.)

18083 (GA-2648) SOME EFFECTS OF NEUTRON IRRADIATION ON SELECTED BERYLLIA MATERIALS. J. Martin Tobin (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Apr. 30, 1962. Contract AT (04-3)-187. 86p.

The effect of 1.7×10^{21} to 2×10^{21} nvt (>1 Mev) integrated fast-neutron flux at elevated temperatures (800 to 980°C) upon the size and shape, density, crack structure, crushing strength, and thermal conductivity is reported for a wide selection of beryllia ceramic materials. The measurements and observations indicated that the use of some fluxing additives results in improved irradiation stability of the properties measured. For the majority of the irradiated beryllia pellets a dimensional increase of less than 1%, a density decrease of less than 3%, a decrease in axial crushing strength of 60% to 80%, and a decrease in estimated thermal conductivity of 15% to 40% were found. (auth)

18084 (LMSD-703735-1) PROTON DAMAGE TO SOLAR CELLS. K. T. Chow and E. A. Lodi (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Aug. 1961. Contract AF04(647)-564. 37p. (AD-265213)

The performance was evaluated of commercially available silicon solar cells which are to be used as a power source in the space radiation field surrounding the earth. The experiment was specifically designed to provide information on the proton radiation encountered by solar cells operating in space. The results indicated that a 25% reduction in maximum power output of the cell occurred at integrated fluxes of approximately 5×10 to the 9th and 10th power protons/sq cm for 3- and 13-Mev protons, respectively. The cells were further irradiated to obtain a reduction in maximum power output of about 40 to 50%. Room-temperature annealing of the cells was observed for a period of four weeks with no significant changes occurring. The proton source, the apparatus for measuring the electrical output of the solar cell, and the results of the experiment are presented. (auth)

18085 (NAA-SR-7098) CAPSULE IRRADIATION OF UNALLOYED URANIUM AT HIGH TEMPERATURES. D. G. Harrington and J. B. Newton (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1962. Contract AT(11-1)-GEN-8. 30p.

Cast and wrought specimens and restrained wrought specimens of unalloyed U were irradiated in the Materials Testing Reactor, as the first in a series of experiments to develop fuel materials for Na cooled reactors. Average central temperatures ranged from 710 to 1280°F, and burnup ranged from 1230 to 2260 Mwd/MTU. The results show severe limitations of these fuel materials for Advanced Sodium Cooled Reactors, and agree substantially with data obtained from larger specimens irradiated in the SRE. The need for careful extrapolations of irradiation results from small accelerated test specimens is clearly indicated, especially in regard to diameter and length changes. (auth)

18086 (NP-11503) MONTHLY ACCESSION LIST NO. 56 [ON RADIATION EFFECTS DATA], MARCH 1 THROUGH MARCH 31, 1962. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Apr. 15, 1962. Contract AF33(616)-7375. 20p.

A bibliography on radiation effects covering material obtained by the Radiation Effects Information Center during March 1962 is presented. The 46 references, with abstracts, are grouped under the following headings: miscellaneous, organic and inorganic compounds, electronics, polymers, metals and ceramics, dosimetry, and space. (M.C.G.)

18087 IRRADIATION EXPERIMENTS AND THEIR IMPORTANCE FOR THE DEVELOPMENT OF FUEL ELEMENTS FOR POWER REACTORS. R. Holzer (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Atompraxis, 8: 118-21(Apr. 1962). (In German)

Irradiation experiments for the design of fuel elements for power reactors are reviewed. Based on experience with the preparation of an irradiation program for the Siemens Multipurpose Research Reactor, which was carried out at the Westinghouse Testing Reactor at Waltz Mills (USA), so-called capsule experiments are described. The capsule design and the selection of a suitable position for the irradiation is discussed and the post-irradiation examinations are reviewed. (auth)

18088 RADIATION EFFECTS ON ELASTICITY MODULUS AND MICROHARDNESS. I. G. Berzina, A. A. Botaki, and P. A. Savintsev (Tomsk Polytechnic Inst., USSR). Izvest Vysshikh Ucheb. Zavendenií, Fiz., No. 6, 30-4(1961). (In Russian)

The elasticity modulus of Pb–Bi and Zn–Cd alloys increases with aging. Slow neutrons, high- and low-energy γ quanta, and x radiation also increase the Young modulus in eutectic alloys and metals. The microhardness of eutectic systems increases with γ and x irradiation. (tr-auth)

18089 EFFECTS OF γ-RADIATION ON DIELECTRIC PROPERTIES OF VINYL PLASTICS. V. M. Nesterov and V. N. Toporova (Tomsk State Univ., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 6, 141-4(1961). (In Russian)

It is shown that irradiation of vinyl plastics with 1.25-Mev γ quanta to a total dose of 10^7 r induces considerable variation in electric properties due to structural changes. (R.V.J.)

18090 HYPERFINE INTERACTIONS IN X-IRRADIATED MAGNESIUM PHOSPHITE HEXAHYDRATE. Melvin W. Hanna (California Inst. of Tech., Pasadena). J. Chem. Phys., 36: 1788-92(Apr. 1, 1962).

An analysis of the electron spin resonance spectra of x irradiated single crystals of $MgHPO_3 \cdot 6H_2O$ showed that the principal long-lived paramagnetic species produced by irradiation is a PO_3 fragment. This fragment retains the same orientation within the unit cell as the undamaged molecule. The parallel and perpendicular components of the diagonal (electron-spin)–(nuclear-spin) coupling dyadic for the phosphorus nucleus are found to be of the same sign and of magnitude 2210 and 1730 Mc, respectively. These results are compared with theoretical values of the distributed dipole and contact hyperfine interactions calculated on the assumption that the unpaired electron is located in an sp^3 hybrid orbital centered on phosphorus. (auth)

18091 LOW DOSE GAMMA IRRADIATION OF SEMICONDUCTOR DIODES. D. E. Vaughan (Royal Military Coll. of Science, Shrivenham, Wilts, Eng.). J. Electronics and Control (1), 12: 233-41(Mar. 1962). (In English)

Investigations were made of the effects of small (10 kilorad) doses of Co^{60} gamma radiation on p–n junction germanium diodes, with particular reference to changes in reverse saturation current and junction depletion capacitance under reverse bias conditions. Significant post-irradiation changes were observed in both parameters and

a mechanism is proposed to explain the major features of the observations. (auth)

18092 A 100 kev HEAVY ION ACCELERATOR FOR THE STUDY OF IRRADIATION DAMAGE. R. W. Barnfield, B. W. Farmery, L. C. W. Hobbis, R. S. Nelson, and M. W. Thompson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 89-93 (Apr. 1962). (AERE-R-3748) (In English)

An accelerator is described which was designed to study irradiation damage in soils. The machine produces beams of protons and ions of the rare gases, He, Ne, Ar, Kr, and Xe, carrying currents up to 100 μa and 10 to 100 kev focused down to spot diameters of the order of a mm on the target. Ions from an r-f source are focused by an Einzel lens and accelerated to final energy in a single gap; the convergent beam is then magnetically analyzed by a 30° sector magnet and directed onto the target by a pair of strong focusing electrostatic quadrupole lenses. An all-metal vacuum system was constructed giving pressures between 10^{-7} and 10^{-6} mm Hg in the target-chamber. (auth)

18093 EFFECT OF IRRADIATION ON PHASE TRANSFORMATIONS IN Cu–Sn AND Cu–Sn–Pu ALLOYS. S. T. Konobeevskii (Konobeevski), B. M. Levitskii (Levitski), L. D. Panteleev, and K. P. Dubrovin (Academy of Sciences, USSR). J. Nuclear Materials, 5: 317-25(Apr. 1962). (In English)

Tin bronze (Cu–8 at. % Sn alloy) with the addition of 1 at. % Pu, in the annealed state, experiences a transformation under neutron irradiation. It consists in the dissolution of the precipitated intermetallic phase Cu_3Sn in the α-solid solution. Even after prolonged exposure to fast neutrons the binary alloy does not show this effect. The explanation of the observed regularities of the transition is based on the concept of thermal spikes in fissile materials. (auth)

18094 OBSERVATION OF FISSION FRAGMENT TRACKS IN SINTERED UO_2. Takeo Kikuchi and Ken-ichi Shiozawa (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 17: 586-7(Mar. 1962). (In English)

Fission fragments in sintered, neutron-irradiated UO_2 were observed using an electron microscope. Track-distribution data are presented in graphical form. (L.N.N.)

18095 ON THE EFFECTS OF QUARTZ CRYSTALS IRRADIATION BY MEANS OF ELECTRONS. F. Porreca (Università, Naples). Nuovo cimento (10), 23: 859-66 (Mar. 1, 1962). (In English)

Quartz crystals of thickness greater than the electron range were irradiated by electron beams accelerated in a microtron. The beam maximum energy is 2 Mev; the intensity is (10^{11} to 10^{12}) electrons/sec; and the irradiation times are 1 and 2 hr. From changes in the optical properties, the depth of blackening produced by 1 and 2-Mev electrons equals the range. The spot intensity is fairly constant, vanishing abruptly at the limit of the range. Absorption spectrum analysis, limited to the visible region, shows the presence of the bands A_1 and A_3. These results are compared with others from other ionization methods. (auth)

18096 KINETICS OF PHOTOCONDUCTIVITY IN NEUTRON IRRADIATED p-TYPE SILICON. A. F. Plotnikov, V. S. Vavilov, and L. S. Smirnov (Lebedev Inst. of Physics, Moscow). Soviet Phys.-Solid State, 3: 2363-7 (May 1962).

Data relating to the concentration of defects introduced into p-type silicon by a fast neutron flux are presented. The hole-capture cross sections of these defects are evaluated; this leads to conclusions concerning the defect charge. (auth)

18097 DYNAMIC POLARIZATION OF PROTONS IN NEUTRON IRRADIATED POLYETHYLENE. V. I. Lushchikov, A. A. Manenkov, and Yu. V. Taran (Lebedev Inst. of Physics, Moscow). Soviet Phys.-Solid State, 3: 2541-4 (May 1962).

The dynamic polarization of protons in polyethylene irradiated with fast neutrons was studied. A twentyfold increase of proton polarization was obtained at 1.6°K in a magnetic field of 3500 oersteds; this corresponds to a 0.45% degree of polarization. The electronic and nuclear spin-lattice relaxation times were measured at 1.6 and 4.2°K. (auth)

18098 EFFECTS OF γ-IRRADIATION ON THE SPECTRAL DISTRIBUTION OF PHOTOSENSITIVITY OF CdS MONOCRYSTALS. T. Ya. Sera, V. V. Serdyuk, and I. M. Shevchenko (Mechnikov State Univ., Odessa, USSR). Soviet Phys.-Solid State, 3: 2568-9(May 1962).

Gamma effects on the CdS photoconductivity spectrum were studied. The long wavelength photosensitivity of CdS monocrystals can be increased by quenching-type thermal processing which promotes the appearance of many microfissures and dislocations in the crystal bulk. Photocurrent spectral distributions prior to irradiation and after 24 and 48 hr of γ irradiation are presented in graphical form. (L.N.N.)

PHYSICS

General and Miscellaneous

18099 (NP-11463(Pt.1)(p.179-85)) NEUTRON–PROTON SCATTERING. H. N. Yadav (Patna, India. Univ.).

Theoretical problems of n–p scattering are discussed. The Born approximation and exact calculations for phenomenological potentials were examined. The use of a pion theoretical potential along with a hard core in explaining experimental collision data at 150 Mev is discussed. (M.C.G.)

18100 (NP-11463(Pt.2)(p.187-94)) STRANGE PARTICLES. P. K. Kabir (Saha Inst. of Nuclear Physics, Calcutta).

The production and properties of strange particles are discussed. The law of associated production is outlined. The extension of isotopic spin to strange particles and its use in their classification are described. The assignment of strangeness values to strange particles is discussed. The behavior of mesons (K^0) is described. (M.C.G.)

18101 (NP-11463(Pt.2)(p.195-211)) WEAK INTERACTIONS. P. K. Kabir (Saha Inst. of Nuclear Physics, Calcutta).

The behavior of particles in weak interactions is discussed. The non-conservation of parity in β-decay and in meson (π) and meson (μ) decay is described. Production of neutrinos in meson decay is discussed. The hypothesis of the universal Fermi interaction is outlined. Coupling constants, decay of strange particles, and symmetry problems are discussed. (M.C.G.)

18102 (NP-11463(Pt.2)(p.213-22)) STRONG INTERACTIONS OF STRANGE PARTICLES. A. N. Mitra (Aligarh Muslim Univ., Aligarh, India).

The strong interactions of strange particles are reviewed. The interactions are formulated on the basis of conventional field theory. Methods of determining spin, parity, and isotopic spin are described. Various models for strong interactions are discussed. (M.C.G.)

18103 (NP-11463(Pt.2)(p.223-32)) THEORY OF CASCADE SHOWERS (REVIEW). S. K. Chakrabarty (Calcutta. Univ. Bengal Engineering Coll., Howrah).

The developments in the analysis of the cascade theory are traced. The latest position regarding the results of such analyses together with an estimate of their order of accuracy are given. (M.C.G.)

18104 (NP-11463(Pt.2)(p.233-8)) ON SOME APPLICATIONS OF THE RESULTS OF THE CASCADE THEORY (REVIEW). S. K. Chakrabarty (Calcutta. Univ. Bengal Engineering Coll., Howrah).

Incorporation of the refinements of the physical processes involved into analyses of the cascade theory is discussed. The way the results which are derived can explain the results of various observations is indicated. The most important physical processes where improvements are desirable were found to be: the variation of the ionization loss with energy of the particles, the transverse development of the shower, and the fluctuation of the shower around the average. (M.C.G.)

18105 (NP-11463(Pt.2)(p.239-53)) APPLICATION OF THE THEORY OF STOCHASTIC PROCESSES TO PHYSICAL PROBLEMS. Alladi Ramakrishnan (Madras. Univ.).

A study of stochastic processes using the mathematics of quantum mechanics is described. The determination of joint distribution function at a finite number of values of the parameter, with which a set of random variables is associated, is discussed. The four classes of stochastic processes are described. A set of mutually exclusive occupation states in any one of which the physical system under consideration could be found with corresponding probabilities was conceived. Markovian processes were considered. Stochastic processes involving back-scattering and their relation to the Feynman paths are discussed. The connection between probability and quantum mechanics is outlined. (M.C.G.)

18106 (NP-11463(Pt.2)(p.255-60)) DEVELOPMENT OF NUCLEON CASCADE. S. C. Ganguly (Calcutta. Univ. Bengal Engineering Coll., Howrah).

Attempts to explain the development of the hard component on the basis of the cascade theory are reviewed. The dependence of the cascades on the form of the collision cross sections assumed, the effects of meson (π) decay on cascades started by the mesons (π), cascade equation solutions, and cascades started by alpha particles in the atmosphere are discussed. A quantitative description of the mixed meson–nucleon cascades developing in finite absorbers and in the inhomogeneous atmosphere was developed. (M.C.G.)

18107 (NP-11463(Pt.2)(p.261-73)) THE STOCHASTIC PROBLEM OF ELECTRON PHOTON CASCADES INCLUDING POLARISATION. R. Vasudevan and N. R. Ranganathan (Madras. Univ.).

The Dyson formulation was transferred to the approach to the cascade theory developed by Ramakrishnan and Srinivasan. The fluctuation problem was also considered. Topics covered are product density of degree one, a new approach to the cascade theory with inclusion of polarization, and product density of degree two. (M.C.G.)

18108 (NP-11463(Pt.2)(p.275-88)) STATISTICAL MECHANICS AND THE PARTITION THEORY OF NUMBERS. F. C. Auluck and D. S. Kothari (Delhi. Univ.).

The determination of the number of ways in which a given amount of energy can be shared out among the different possible states of an assembly is discussed. Both restricted and unrestricted partitions are described. The concept of partition was extended to non-integral summands. The partitions of bipartite numbers are discussed. (M.C.G.)

18109 (NP-11463(Pt.2)(p.289-312)) POLYMERS AND THEORY OF NUMBERS. V. S. Nanda and R. K. Pathria (Delhi. Univ.).

The degradation process of linear polymers was studied using the theory of numbers. The case of a mono-disperse material in which each of the chains undergoes the same number of cuts at any stage of the degradation process was considered along with the case when the member chains possess two types of links of different strength. The discrepancy that exists between the results obtained from the probability approach and those from a different approach due to Tuckett was resolved. (M.C.G.)

18110 (NP-11463(Pt.2)(p.313-23)) ON AN ESSENTIALLY STATISTICAL FORMULATION OF RATIONAL THERMODYNAMICS. M. Dutta (Jadavpur Univ., Calcutta).

A mathematical model based on statistical considerations was developed for rational thermodynamics. The system under consideration consists of some finite quantities of two entities enclosed in a definite locality in a definite en-

vironment where there is no hindrance on free transfer of these entities between the system and the environment. The influence of variations in the environment was also considered. The laws of microscopic distribution are discussed. (M.C.G.)

18111 (NP-11463(Pt.2)(p.325-35)) LOW TEMPERATURE BEHAVIOUR OF A BOSE GAS WITH HARD SPHERE INTERACTION. R. K. Pathria and A. D. Singh (Delhi. Univ.).

The thermodynamic properties of a Bose gas were studied as a function of the particle density and the hard-sphere diameter. This problem was investigated for those cases in which the non-monotonic character of the energy spectrum is not important. The case when the oscillating term in the energy spectrum becomes so influential that it gives to this relation the non-monotonic character was also studied. The hard-sphere interaction was used to account for the two types of excitations: phonons and rotons in a single scheme. (M.C.G.)

18112 (NP-11463(Pt.2)(p.337-9)) A SIMPLE DERIVATION OF THE EXPRESSION FOR THE VELOCITY OF SECOND SOUND IN HeII. D. V. Gogate (Maharaja Sayajirao Univ. of Baroda, India).

An expression was derived for the velocity of second sound in helium (liquid). The resulting expression was the same as that derived by Landau. (M.C.G.)

18113 (Np-11463(Pt.3)(p.357-63)) PROPERTIES OF REAL GASES AT HIGH TEMPERATURES AND PRESSURES. Kartar Singh (India. Inst. of Armament Studies, Kirkee).

An attempt was made to calculate the temperature, pressure, and velocity of detonation in silver azide. The potential energy is given in terms of these probability functions. The Lennard Jones-Devonshire equation of state was used in the investigations. Repulsive potentials were determined for use in the calculations. (M.C.G.)

18114 (NP-11463(Pt.3)(p.419-29)) STELLAR EVOLUTION AND NUCLEOGENESIS. R. S. Kushwaha (Delhi. Univ.).

The problem of stellar evolution was studied. The basic equations governing the stellar structure are given. Theoretical models representing a star at different times were developed. To explain the cosmic abundance curve on stellar hypothesis, eight types of nuclear processes were postulated as occurring at different phases of evolution to produce different nuclei. (M.C.G.)

18115 (NP-11463(Pt.3)(p.431-46)) AN ANALYSIS OF THE PROBLEM OF STELLAR STRUCTURE. U. R. Burman (Calcutta. Univ.).

The theoretical problem of stellar structure was formulated. The equations of equilibrium, the perfect-gas equation of state, the equation of radiative equilibrium, and the solution to the system of equations are given. The energy generation law and stellar models are discussed. (M.C.G.)

18116 (NP-11463(Pt.3)(p.447-55)) STABILITY PROBLEM IN MAGNETO HYDRODYNAMICS. F. C. Auluck (Delhi. Univ.).

The effects of a magnetic field on gravitating spheres were studied. It is shown that with Ferraro currents it is possible to have a spherical configuration in equilibrium. A generalization of the Chandersekhar and Fermi model was considered. The case where volume currents are present was also investigated. (M.C.G.)

18117 (NP-11463(Pt.3)(p.457-72)) PLASMAS AND THEIR OSCILLATIONS. P. L. Bhatnagar (Indian Inst. of Science, Bangalore).

The basic equations for the study of the behavior of plasmas are reviewed. The motion of a charged particle in a magnetic field and some of its consequences are described. Plasma oscillations are discussed under certain simplifying assumptions. Excitation of plasma oscillations by interpenetration of streams of charged particles is also described. (M.C.G.)

18118 (NP-11463(Pt.3)(p.473-80)) HYDROMAGNETIC MODEL FOR A QUIESCENT PROMINENCE. P. L. Bhatnagar (Indian Inst. of Science, Bangalore).

Hydromagnetic models for quiescent prominences with different types of magnetic fields are discussed. A two-dimensional model was developed in which the lines of force start from and terminate in a point in the chromosphere. The postulated field may be realized from the magnetic field associated with a bipolar sunspot. (M.C.G.)

18119 (NP-11463(Pt.3)(p.481-7)) EXACT SOLUTION OF THE EQUATIONS OF CHARGED PARTICLES IN A PLANE ELECTROMAGNETIC RADIATION FIELD AND THE COMPTON SCATTERING. R. C. Majumdar (Delhi. Univ.) and S. Gupta (Indian Inst. of Tech., Kharagpur).

Work done to obtain the distorted wave function for an electron and for a meson of spin one or zero in the presence of a plane electromagnetic radiation field is reviewed. Its effect on Compton scattering by free electrons was investigated. (M.C.G.)

18120 (NP-11463(Pt.3)(p.489-500)) THE THEORY OF DISTRIBUTIONS AND ITS APPLICATIONS TO FIELD PHYSICS. P. K. Ghosh (Calcutta. Univ. Coll. of Science).

Generalizaton of the notion of a function is discussed including test functions, null sequences, distributions, and convergence. Differentiation of distributions is described. Pseudo-functions, multiplication of distributions, convolution of products, integration of distributions, the Fourier series, Fourier and Laplace transforms, and applications of the theory of distributions are discussed. (M.C.G.)

18121 (RADC-TN-61-199) ELECTRONIC AND NUCLEAR PARAMAGNETISM AND ENERGY TRANSFER MECHANISMS IN CRYSTALLINE SOLIDS. Technical Note No. 1, September 1, 1960 to August 31, 1961. William A. Barker, John J. Hill, Mohan Lal Narchal, Robert O'Brien, and Thomas Hynes—Vincent P. Jacobsmeyer, comp. (Saint Louis Univ.). Contract AF30(602)-2204. 166p.

Static nuclear polarization at low temperatures, and dynamic orientation of nuclei are discussed. The development of detection apparatus for double resonance is described. The radiofrequency field, magnetic resonance of x_2^- centers, and double resonances in diphenyl pycryl hydrazyl and sodium dispersion in mineral oil were measured. (M.C.G.)

18122 (UCRL-6769) LASERS. A Bibliography. Carl J. Wensrich (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 1962. Contract W-7405-Eng-48. 13p.

A bibliography is presented on light amplification by simulated emission of radiation (LASER). All of the standard library sources were used. (About 120 references.) (J.R.D.)

18123 (UCRL-9954) THE MEASUREMENT OF RADIATIVE LIFETIMES (thesis). Robert Berg (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1962. Contract W-7405-eng-48. 108p.

Equipment is described for measuring radiative lifetimes by the phase shift method. A rotating wheel light modulator of unique design, operating at 60 kc, is used to study lifetimes from 10^{-5} to 10^{-7} sec; light is modulated

at 5.2 Mc by ultrasonic waves in a water tank to study lifetimes from 10^{-7} to 10^{-3} sec. Many optical and electronic sources of error were studied, and procedures were developed to minimize their effect on the accuracy of experimental results. The radiative lifetime of the visible fluorescence of barium cyanoplatinate – $BaPt(CN)_4 \cdot 4H_2O$ – was determined. Measured lifetimes of fluorescence excited by uv light ranged from 3.0 to 7.0×10^{-7} sec on different samples. Variation of lifetimes in that range was also observed on the same sample at different times. The excitation spectrum of the fluorescence was recorded; fluorescence of one sample excited by spectral lines near the peak of excitation (Cs lines 4555Å and 4593Å) decayed with a lifetime of 8×10^{-7} sec. The measured lifetime range is in agreement with that found by Tolstoi et al; they also observed different lifetimes with different samples. The scatter in the data may be due to variation of water of hydration or different crystal orientations in the samples. The radiative lifetime of I_2 fluorescence $B^3\Pi_{0^+u}$ ($v' = 26$) $\rightarrow$ $X^1\Sigma_{0^+g}$ was determined to be $(7.2 \pm 1.0) \times 10^{-7}$ sec. Measurements on equilibrium vapor were made at 10^{-4} to 5 mm Hg, corresponding to −50° to +65°C. Measurements at the lowest pressures were considerably shorter than the true lifetime because of low optical signal-to-noise ratios; an analytical procedure was developed to correct measured lifetimes for this effect. At higher pressures self-quenching of the fluorescence became increasingly important. Data for fluorescence self-quenching were treated by the Stern-Volmer method; a quenching collision cross section of 11.3 A was determined. Measurements were also made with molecular beams of I_2. Slightly higher lifetimes were measured than in equilibrium vapor. The data are consistent with a mean free path in the beam ≈3 times that in equilibrium vapor at the same density. The lifetime indicated above differs by almost two orders of magnitude from the only other direct measurement reported in the literature. However, it is in good agreement with absorption data, calculations of the transition probability, and inferences from experiments on vibrational energy transfer in I_2. (auth)

18124 (UCRL-10113) PHYSICS DIVISION SEMI-ANNUAL REPORT, MAY THROUGH OCTOBER 1961. (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 5, 1962. Contract W-7405-eng-48. 57p.

A large portion of the activity during the period was devoted to design, construction, and operation of a K^- beam at the Bevatron for use in conjunction with the 72 in. bubble chamber. Other research is reported concerning pions, strange particles, heavy ions, space, and particle track analysis. Details of fundamental physics research are also included along with descriptions and data related to bubble chamber and accelerator operations. (J.R.D.)

18125 (AEC-tr-5066) METHOD FOR INVESTIGATING THE SECONDARY EMISSION UPON BOMBARDMENT OF THE CONDUCTORS WITH IONS. U. A. Airfov, A. Kh. Ayukhanov, and S. V. Starodubtseva. Translated by Lydia Venters (Argonne National Lab., Ill.) from Zhur. Eksptl'. i Teoret. Fiz., 26: 714-22(1954). 13p.

Methods of investigating secondary emission from target impact by ions are discussed. Oscillographic methods are suggested which allow measurements to be carried out under pure experimental conditions. A method of double modulation is described by which the proper secondary emission can be separated from the accompanying surface ionization. (J.R.D.)

18126 (DC-58-9-84) SOVIET COMMENTS ON THE DEFINITION OF RADIATION UNITS. J. H. Guill, comp. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Translated from Izmeritel'naya Tekh., No. 1, 31-5(1955); Ibid., No. 1, 15-23(1956). 60p.

Five papers are included for which separate abstracts were prepared. (J.R.D.)

18127 (DC-58-9-84(p.1-13)) COMMENTS ON THE PROBLEM OF THE NEW DEFINITION FOR THE UNITS OF X- AND GAMMA-RADIATIONS AND RADIOACTIVITY. M. F. Yudin. Translated from Izmeritel'naya Tekh., No. 1, 31-5(1955).

An analysis of various roentgen definitions is presented along with recommendations that this unit be regarded as a unit of x and gamma radiation defined as a dose in air at which ions are being formed with a total charge of 1 esu of electricity per 0.001293 g air. A roentgen/sec is the dose rate in air at which the dose evenly increases by 1 roentgen in 1 sec. (J.R.D.)

18128 (DC-58-9-84(p.14-16)) ON THE DEFINITION OF THE ROENTGEN. P. M. Tikhodeev (Tikhodeyev). Translated from Izmeritel'naya Tekh., No. 1, 15-16(1956).

A review and analysis of Comments on the Problem of the New Definition for Units of X and Gamma Radiations and Radioactivity (DC-58-9-84(p.1-13)) is presented. (J.R.D.)

18129 (DC-58-9-84(p.17-22)) ON THE SHORTCOMINGS OF THE NEW DEFINITION OF THE ROENTGEN. V. I. Ivanov. Translated from Izmeritel'naya Tekh., No. 1, 16-18(1956).

In an analysis of the definition of the roentgen it is noted that the conditions of absorbed energy transformation are not stipulated. Other defects in the definition are analyzed and it is concluded that the definition is impracticable for very hard radiation dose assessment and that correction factors should be introduced in determining tissue doses for very soft rays. (J.R.D.)

18130 (DC-58-9-84(p.23-7)) MORE ON THE PROBLEM OF ROENTGEN DEFINITION. M. F. Yudin. Translated from Izmeritel'naya Tekh., No. 1, 18-19(1956).

A further substantiation is presented of the proposal found in Comments on the Problem of the New Definition for the Units of X- and Gamma-Radiations and Radioactivity (DC-58-9-84(p.1-13)) that the roentgen can be applied for doses produced by radiation for which the average work of ionization can be estimated as equal to 33 ev. (J.R.D.)

18131 (DC-58-9-84(p.28-38)) DEFINITION OF THE ROENTGEN IN CONNECTION WITH THIS UNIT'S APPLICATION FOR ALL IONIZING RADIATIONS. I. V. Poroikov. Translated from Izmeritel'naya Tekh., No. 1, 20-3(1956).

Revision of the All-union State Standard for the roentgen is discussed. It is recommended that the roentgen be considered a unit of ionization and roentgen/sec should be called increment of ionization instead of dose rate. (J.R.D.)

18132 (FTD-TT-61-310) ELECTRIC CURRENT WITHOUT TURBINE. Robert Szewalski. Translated from Przeglad Tech., No. 21, 3-(May 24, 1961). 5p.

The principles of magnetohydrodynamic generators are discussed. The development and use of these generators are described. (M.C.G.)

18133 (FTD-TT-62-120) MAGNETOHYDRODYNAMIC GENERATORS. Wojciech Brzozowski. Translated from Nukleonika, 6: 555-63(1961). 16p.

Results of experiments devoted to obtaining electricity directly from heat are presented. Low-power magnetohydrodynamic generators operating on argon were used. Tests in which KCl and K_2CO_3 were used for seeding are described. (J.R.D.)

18134 (FTD-TT-62-227) A WORKING SUBSTANCE FOR MAGNETOHYDRODYNAMIC ELECTRIC MACHINES. E. (Ye.) I. Yantovskii (Yantovskiy). Translated from U.S.S.R. Patent No. 128,950. Sept. 7, 1959. 3p.

An invention is described which pertains to use of a Ne–Cs vapor mixture in synchronous magnetohydrodynamic machines with rotating inductors. The air gap in these machines contains a chamber through which the working mixture passes. Maximum electric conductivity is achieved by use of the mixture. (J.R.D.)

18135 (HW-tr-34) THE BEHAVIOR OF RARE GASES IN SOLIDS AT HIGH TEMPERATURE. J. Blin (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Translated by E. R. Appleby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) from report CEA-1444. 1960. 47p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 19535.

18136 (AD-261668) THEORETICAL INVESTIGATIONS AND DESIGN STUDIES FOR THE EVENTUAL CONSTRUCTION OF A MEASURING DEVICE IN THE FIELD OF PLASMA ELECTRONICS. PART II: CORRECTION OF ANGULAR AND RANGE ERRORS. Monthly Technical Status Report No. 21, April 1961. (Battelle-Institut e. V., Frankfurt am Main). May 31, 1961. Contract DA-91-591-EUC-1018 OI-1165-59. 8p.

The angular deflection of electromagnetic waves by the atmosphere was studied. Tests were conducted for the angular deflection of $\lambda = 3$ cm waves by a paraffin prism. Theoretical considerations proved that by using a section of a rotational ellipsoid as a reflector, a better field strength concentration could be obtained than was the case using a normal parabolic reflector. Plasma penetration measurements were also performed. A plasma with an electron concentration of $10^{11}/cm^3$ was produced by a current of 50 amp. (auth)

18137 (AD-264847) MOMENTUM OF ELECTRONS IN SOLIDS. Annual Technical Report, September 1, 1960–September 1, 1961. K. [D.] Alexopoulos (Athens. Univ.). Contract DA-91-591-EUC-1557. 8p.

Free electrons inside a metal in a continuous movement are studied. This movement of the electrons colliding with the photons causes Doppler effect which has as a result a broadening of the Compton scattering. The profile of the Compton band is a function of the momentum distribution of the electrons contributing to the scattering. The study of this profile presents the most direct method for the investigation of the momentum distribution. (auth)

18138 (AD-265461) OPTIMIZATION OF THERMOELECTRIC ENERGY CONVERTERS. Bimonthly Progress Report No. 4, October 15, 1960–December 14, 1960. Philipp H. Klein, ed. (General Electric Co. Aircraft Accessory Turbine Dept., Lynn, Mass.; General Electric Co. General Engineering Lab., Schenectady, N. Y.; and General Electric Co. Electronics Lab., Syracuse, N. Y.). Contract NObs-78403. 48p.

Improvements in performance that may result from the advancement of the art of preparation of materials were analyzed, using the first thermal system as a model. This system consists of saturated steam at 533°K as the heat source, a thermoelectric converter of conventional design, and sea water at 291°K as the heat sink. The performance of the system containing a hypothetical material (maximum figure of merit: 5.5×10^{-3} $(°K)^{-1}$; density: 7.80 g/cm^3) is such that efficiencies more than twice those obtained with the "best" materials currently available can be expected for a given specific power output. Progress is also reported on the NOBS-3 computer program, in which thermal and electrical losses are considered in a completely rigorous manner. In addition, the second thermal system has been selected. No specific temperatures were chosen, but these will be picked to represent the maximum values at which the materials to be considered are operable. The system will include provision for such techniques as encapsulation and segmentation of thermoelectric arms. Work on encapsulation of thermoelectric materials included the preparation of two couples containing p-type and n-type PbTe. It was found possible to encapsulate p-type PbTe with the addition of only two wt. % each of sodium carbonate and elemental Te. Magnesium antimonide was also successfully encapsulated, although it exhibited excessive and non-reproducible electrical resistivity at elevated temperatures. In the search for improved ceramic materials, it has been found that magnesia–titania is a tractable and useful material, perhaps representing a distinct improvement over the forsterite currently in use. Magnesium bismuthide was prepared and its Seebeck coefficient and electrical resistivity determined at somewhat elevated temperatures. Measurements of the electrical resistance of a specimen of un-encapsulated magnesium antimonide at temperatures up to its melting point disclose the same anomalous "hysteresis" as was observed with an encapsulated sample. A polarized-reflectance method was applied to the determination of the band-gap energy of CrSb, yielding the room-temperature value of 0.6 ev for E_G. This agrees reasonably well with the value previously determined by non-polarized reflectance methods, 0.8 ev, but is not consistent with electrically-determined results. The Seebeck coefficient of CrSb was determined from room temperature to 700°C. The data verify the prediction that the compound is a degenerate p-type semiconductor. Approximate room-temperature values for the figures of merit of stoichiometric calcium stannide, calcium plumbide, and strontium stannide have been determined. The highest value obtained was about 7×10^{-4} $(°K)^{-1}$, using the last-named substance. Measurements of the thermoelectric properties of these and other II-IV compounds are in progress, both at room temperature and at elevated temperatures. (auth)

18139 (AD-265764) CESIUM PLASMA STUDIES FOR THERMIONIC ENERGY CONVERSION. Semi-Annual Technical Summary Report. R. C. Knechtli and J. Y. Wada (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). Oct. 1961. Contract Nonr 3501(00). 19p.

A new method for direct measurement of the recombination coefficient a of Cs plasmas was developed. Further measurements to determine the actual value of a rather than an upper limit are in preparation. The effect of emitter temperature and Cs vapor pressure on the formation of sheaths on a Cs plasma emitter was investigated theoretically and experimentally. The Cs plasma emitter is a hot W or Ta disk in Cs vapor; ions are produced by contact ionization and electrons by thermionic emission. Good agreement was obtained between theory and experiment, demostrating that readily controllable electron or ion sheaths could be obtained. Correlation was established between the existence of excess noise in the plasma and the presence of an electron accelerating ion sheath at the plasma emitter. (auth)

18140 (AD-266087) KINETIC EQUATIONS FOR GASES IN EXTERNAL FIELDS. James E. McCune and Guido Sandri (Aeronautical Research Associates of Princeton, Inc., Princeton, N. J.). Sept. 1961. Project SQUID. 30p. (ARAP-1-R)

The kinetic equation valid for a gas with short-range forces in an externally applied field is derived from the Liouville equation. The correction to the Boltzmann equation linear in eta T (the ratio of the time required for two particles to reach their asymptotic momentum in a two-body collision to the time required for the field to bring a particle from rest to thermal speed) is calculated. This correction is shown to vanish identically in the weak coupling limit. (auth)

18141 (AD-266220) THERMOELECTRICITY QUARTERLY PROGRESS REPORT NO. 1, APRIL 1, 1961–AUGUST 1, 1961. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Aug. 1, 1961. Includes Papers: THEORETICAL REQUIREMENTS FOR THERMOELECTRIC MATERIALS. Research Report 929-8904-R2. P. G. Klemens. July 12, 1961; and MODEL FOR THE ELECTRONIC TRANSPORT PROPERTIES OF MIXED VALENCY SEMICONDUCTORS. Scientific Paper 929-8904-P1. R. C. Miller, R. R. Heikes, and R. Mazelsky. June 27, 1961. Contract NObs-84687. 39p.

The thermoelectric properties of a solid were determined by the functional form of $\sigma(E)$, the electrical conductivity of electrons of energy E. In order for the Seebeck coefficient to be high, $\sigma(E)$ must vary rapidly over a narrow energy range. Possible methods of realizing this condition are discussed. It is shown that the simple hopping model for the transport processes of mixed valency semiconductors is inadequate for impurity concentrations approximately greater than 1%. (auth)

18142 (AD-266553) MAGNETOHYDRODYNAMICS AND ENERGY CONVERSION. Technical Progress Report No. 4, for period Ending August 31, 1961. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Sept. 15, 1961. Contract AF33(616)-7624. 20p.

Progress is reported in experiments with a generating system in which solid conductors are used to traverse a coil and vary the inductance. Other research is reported on the oscillations observed in Cs thermionic converters, and on the temperature distribution in long thin struts that are conducting heat and radiating. Work on a magnetically driven t-type shock tube is also reported. (J.R.D.)

18143 (AFOSR-1440) USE OF THERMAL GREEN'S FUNCTION FOR THE ELECTRON-ION INTERACTION IN SUPERCONDUCTORS. Technical Note No. 12. T. Nishiyama (Weizmann Inst. of Science, Rehovoth, Israel). June 20, 1961. Contract AF 61(042)-337. 44p. (AD-264835)

Starting with the Bardeen and Pines Hamiltonian for metals, the screening effect of the electron-ion interaction and the change of frequency of the ionic oscillation in superconductors were considered by introducing a Hartree field in place of the pairing interaction of Cooper. Use is made of the method of thermal Green's functions which affords analytically tractable results. A method was proposed to determine a number of parameters involved in the Hartree field in a self-consistent way. (auth)

18144 (ARL-16) RESEARCH PROGRAM IN RELATIVITY PHYSICS. H. Bondi (London. Univ., Kings Coll.). May 1961. Contract AF 61(052)-48. 14p. (AD-266359)

Development of theory concerning the physical properties of gravitational radiation through the analysis of certain exact solutions is reported. A number of approximate results were obtained in the theory of gravitational radiation from finite systems including an unambiguous formula for mass loss due to radiation in suitable circumstances. Advances are also reported in the understanding of the gravitational field energy concept and the mechanisms of its transfer, in the classification of gravitational fields, especially radiation fields, and in understanding of local dynamical phenomena relations to optical observations of distant matter through the study of anisotropic cosmical models. A better understanding of the epistomological structure of Einstein's gravitational theory and of its relation to other possible theories of gravitation was also achieved. (auth)

18145 (ASD-TR-61-11(Vol.II)) SOLAR CELL ARRAY OPTIMIZATION. VOLUME II. (Radio Corp. of America. Astro-Electronics Products Div., Princeton, N. J.). Oct. 1961. Contract AF33(616)-7415. 85p.

Fabrication and testing of photovoltaic materials and design of solar-cell arrays for maximum conversion of solar energy with minimum weight are described. Evaporated layer cells with an efficiency of up to 4.5% over an area of 1.6 cm^2 were fabricated. Research on crystal layer conversion reduced the temperature for recrystallization from 500 to 300°C. Two models of solar-cell arrays to simulate a 100 ft^2 system were fabricated: the telescoping sail with a density of 0.075 lb/ft^2, and the inflatable torus sail with a density of 0.04 lb/ft^2. The maximum area of individual cells was increased by a factor of 27, thickness of substrate reduced by factor of 6, and weight reduced by factor of 7. (auth)

18146 (ASD-TR-61-102) A HYDROMAGNETIC D-C CONVERTER. Edward S. Pierson (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Jan. 1961. Contract AF33(616)-7624. 61p. (AD-265199)

The equations of hydromagnetics and channel flow are presented. The hydromagnetic d-c converter is discussed, and equations and an equivalent circuit are derived. The performance of the fluid generator with armature reaction is given, and the end effects are discussed. The theory is applied to the design of a converter, design equations are developed, and a design example for a converter with an efficiency greater than 50% is worked through. The effect of armature reaction on the design is demonstrated to show that compensation is necessary. The hydraulic design of the converter is discussed. The experimental model of the converter is described, and the theoretical and experimental performances are compared. The experimental results are presented in a series of graphs, and it is shown that the quantities vary as expected. (auth)

18147 (ASD-TR-61-125) EFFECTS OF THERMAL VELOCITIES IN MAGNETICALLY FOCUSED ELECTRON BEAMS. J. L. Palmer (California. Univ., Berkeley). Apr. 5, 1961. Contract AF33(616)-6139. 137p. (AD-267039)

Models for representing an axially symmetric, magnetically focused electron beam, such as the laminar model, the optical model, and the ballistic model, are analyzed mathematically and the computed behavior of each is compared with experimental observations of real electron beams. The over-all behavior of the laminar model agrees to some extent with the behavior of real electron beams; however, the motion of individual electrons or groups of electrons is not at all well predicted by the laminar model. The optical model describes with good accuracy the motion of individual electrons or groups of electrons, as well as the over-all behavior of real beams. The spreading of a beam by thermal velocities and the appearance of images in the current density at periodic intervals along a beam, phenomena that are observed experimentally, are predicted accurately by the optical model. Simple forms of lens aberrations are also treated with the aid of the optical model. (auth)

18148 (ASD-TR-61-704) STUDY OF ELECTRICAL ENERGY CONVERSION SYSTEMS. Final Report. Arthur Sherman, G. W. Sutton, John M. Smith, F. A. Robben, B. Zauderer, Sheldon Belcher, and W. Fried (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Nov. 1961. Contract AF(616)-7539. 115p.

A number of theoretical and experimental investigation were carried out to investigate magnetohydrodynamic (MHD) and electrohydromagnetic (EHD) power generation. The theoretical studies included analysis of both optimum channel configuration and optimum initial conditions for an MHD generator, as well as an analysis of the performance of an idealized EHD generator. The experimental studies centered largely on non-equilibrium ionization experiments using a plasma jet as a source of high temperature gas. Finally, some calculations were carried out for the constant-velocity MHD generator performance, and the investigation of an oxy-cyanogen MHD generator was begun. (auth)

18149 (BRL-1137) TRANSIENT SKIN EFFECTS IN EXPLODING WIRE CIRCUITS. F. D. Bennett (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Aug. 1961. 32p. (AD-265076)

The transient response of the coaxial, current-measuring shunt commonly used in high-current, high frequency applications (up to 1 mc) is analyzed by Laplace transform methods. An approximate solution is obtained which allows estimates to be made of the expected errors. The current shunt measuring a damped oscillation always reports initial current slopes of zero, and the maximum rate of current rise is sensed shortly after switch-on. It is several percent low in typical cases. At the first current maximum, the shunt reading is a few tenths percent high and lags the impressed current by a small fraction of a cycle. The transient resistance of an idealized plate condenser is analyzed using the asymptotic solution for current. A numerical calculation indicates that no alteration of initial conditions on the damped oscillation arises from this source, so long as the characteristic damping time of the transient skin effect is small compared with the ringing time. (auth)

18150 (EURAEC-65) RESEARCH ON DIFFUSION OF INERT GASES IN SOLIDS. Quarterly Report No. 3, January 1, 1961–March 31, 1961. (Hahn-Meitner-Institut für Kernforschung, Berlin). Apr. 24, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract [019-60-7RDA]. 17p. (EU-B4)

Work was continued on the determination of the diffusion coefficients of KCl monocrystals. A uniform diffusion mechanism, in accordance with theory, was observed at 400 to 820°C. Additional improvements were needed in the measurement techniques used for the UO_2/Xe and UC/Xe systems to eliminate the strong influence of O traces. Details of this work are included. With a sintered specimen of ThO_2, the Xe diffusion was immeasurably small up to 1000°C. Experiments with a fine-grained powder are under way. (auth)

18151 (HW-72586) PHYSICS RESEARCH QUARTERLY REPORT, OCTOBER, NOVEMBER, DECEMBER 1961. (General Electric Co. Hanford Atomic Products Operation, Richland). Jan. 31, 1962. Contract AT(45-1)-1350. 86p.

Nine papers are presented on applied and nuclear physics research. Separate abstracts were prepared for eight papers. One was previously abstracted for NSA. (M.C.G.)

18152 (HW-72586(p.4-8)) GREEN'S FUNCTION TREATMENT OF EXPONENTIAL PILES–III. C. W. Lindenmeier (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The cadmium shutter method for measuring lattice parameters was analyzed from a Green's function approach. Background effects and spectral shift effects for the driving source are essentially eliminated. The flux difference behaves as if there were no driving source in the region above the shutter. The expression obtained is being compared with experimental results. (M.C.G.)

18153 (HW-72586(p.9-10)) EPITHERMAL CORRECTIONS TO BARE ACTIVITIES OF Cu^{64} AS A FUNCTION OF MODERATOR TEMPERATURE. R. A. Bennett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Values of α (activation by epithermal neutrons) for Cu^{63} were calculated with Westcott (W) and Hurwitz (H) spectra for various moderator temperatures. The values of α_W^{63} and α_H^{63} are given in tabular form. The results were normalized to a value of 5 lb for the dilute resonance integral for activation of Cu^{63}. (M.C.G.)

18154 (HW-72586(p.11-20)) REDUCTION OF HARMONIC CORRECTION EFFECTS IN EXPONENTIAL PILE MEASUREMENTS. D. E. Wood (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The effect of the correction (C_{11}) for harmonics generated by point neutron sources on the vertical traverse which determines the relaxation length in the exponential pile was considered. Horizontal traverses and extrapolation distances are discussed in terms of possible reduction in harmonic content. A sample case is given in which the data were taken in a position that minimizes the harmonic correction. When positions of the sources and detector were chosen to make the harmonic corrections negligible, data points for $Z < 12$ still fell above an exponential curve fitted to the remaining data. Thus a systematic error in analysis was found to exist which was not directly related to the harmonic correction. (M.C.G.)

18155 (HW-72586(p.21-7)) NORMALIZATION FOR THE MEASUREMENT OF THE FAST FISSION FACTOR. D. E. Wood and K. R. Birney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Measurement of the fast fission factor was accomplished by counting gamma rays from fission products of uranium foils irradiated in the fuel of a reactor lattice. A dual fission chamber was used to measure the relationship between fissions and fission-product gammas for U^{235} and U^{238}. The result was the factor P (the ratio of fissions in U^{235} per fission product gamma from U^{235} to fissions in U^{238} per fission product gamma from U^{238}) which was found to be 1.12 ± 0.01. This value was constant with time for times greater than 4 hr after irradiation. Small changes in crystal size or counting bias did not effect P. (M.C.G.)

18156 (HW-72586(p.28-34)) AN EXTERNAL THERMAL COLUMN FOR THE PCTR. R. I. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A graphite thermal column was constructed for use with the PCTR to perform foil irradiations simultaneously in the thermal column and in the test core. Activation traverses were made through the reactor core, reflector, and thermal column to determine the neutron flux level as a function of position. The effect of the addition of the graphite thermal column on the reactivity of the PCTR was also investigated. The data are presented in graphs and tables. (M.C.G.)

18157 (HW-72586(p.35-43)) MONTE CARLO CALCULATIONS OF k_∞ FOR HOMOGENEOUS SYSTEMS OF

THREE PERCENT ENRICHED UO_3. C. R. Richey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The HISMC Monte Carlo Code was used for calculating the values of k_∞ in the PCTR for homogeneous moderated mixtures of 3%-enriched UO_3. The calculations were carried out for various hydrogen-to-uranium atom ratios in the range 0 to 43.87. The data on the infinite multiplication factors are summarized in tabular form along with the calculated values for Fermi age, migration area, mean life of the neutron, and the mean slowing down time of neutrons. The value for k_∞ decreased rapidly at low hydrogen-to-uranium ratios. The oxygen effect in dry UO_3 was determined. (M.C.G.)

18158 (HW-72586(p.54-65)) CRITICAL MASS EXPERIMENTS WITH PLUTONIUM–NITRATE SOLUTIONS. E. D. Clayton, W. A. Reardon, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Critical mass experiments were continued with plutonium concentrations ranging from 36.3 g/l at 3.3M HNO_3 with a 4-in. concrete reflector to 238.0 g/l at 5.21M HNO_3 with a 1.0-in. paraffin reflector. The corrections for reflector savings and nitrate ion concentration were derived from the experiments, and the experiments reduced to equivalent, bare critical systems. Data for evaluating the reflector savings of stainless steel were obtained. The worth of stainless steel as a reflector in combinations of stainless steel and paraffin were estimated. A coefficient was derived relating the nitrate–ion concentration to the critical volume. (M.C.G.)

18159 (HW-72586(p.66-78)) CALCULATIONS OF CRITICALITY PROPERTIES OF PLUTONIUM–NITRATE SYSTEMS. W. A. Reardon and J. D. White (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Critical masses, radii, and volumes were computed for aqueous homogeneous plutonium nitrate solutions of 2, 4, and 6M HNO_3, and in both bare and reflected spherical geometry. The effect of Pu^{240} was considered by computing these values for 0, 2.5, 5, and 7.5 wt % Pu^{240} dilution. (M.C.G.)

18160 (HW-SA-2536) RADIATION UNITS. H. M. Parker and W. C. Roesch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1962. Contract AT(45-1)-1350. 29p.

A historical review is presented concerning the development of radiation units. A detailed review of recent refinements and developments is included. (J.R.D.)

18161 (ML-779) SPACE-CHARGE THEORY FOR ION BEAMS. Scientific Report No. 28. G. S. Kino and K. J. Harker (Stanford Univ., Calif. Microwave Lab.). Feb. 1961. Contracts AF19(604)-1930 and AF30(602)-1844. 51p. (AFCRL-54; RADC-TN-61-159; AD-263848).

Analytical methods for deriving space-charge flow solutions are reviewed. Certain exact solutions in which the ions flow in circular trajectories are discussed, and form a natural accel-decel solution suitable for ion guns to be used for ion propulsion. The advantages and the disadvantages of these exact solutions are discussed. The approach to the problem using paraxial solutions is also described. Such paraxial solutions enable the uniformity of current density at the emitting anode to be adjusted. Analytical methods of electrode design are discussed, and it is shown how electrodes can be derived for any analytical space-charge flow solution. (auth)

18162 (MRL-103) HARTREE-FOCK WAVE FUNCTIONS FOR THE 4p SHELL ATOMS. R. E. Watson (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.), and A. J. Freeman (Watertown Arsenal. Materials Research Lab., Mass.). June 1961. 16p. (AD-263269)

Conventional (or restricted) Hartree-Fock wave functions were obtained for Ga^+, Ge^{2+}, Br^-, Rb^+, and the neutral atoms Zn, Ga, Ge, As, Se, Br, and Kr. Analytic Hartree-Fock methods utilizing a version of Nesbet's symmetry and equivalence restrictions were used to obtain the solutions in analytic form (sums of powers of r times exponentials). Results are given in the form of wave functions, one-electron energies, and total energies. Comparison is made with the earlier results for Zn and Kr, the only atoms in this group for which H-F solutions exist. (auth)

18163 (NARF-61-8T) NUCLEAR R AND D. (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). July 1, 1961. 132p. (FZK-9-164; AD-263423)

A description of the nuclear research and development capability of General Dynamics/Fort Worth is presented. Major activities are discussed in terms of interest fields, background, and facilities and equipment. A bibliography concerning typical end products of the various activities is included. (J.R.D.)

18164 (NP-11463(Pts.1,2 and 3)) STUDIES IN THEORETICAL PHYSICS. Proceedings of the Summer School of Theoretical Physics Held at Mussoorie, May 22 to June 18, 1959. (India. Ministry of Scientific Research and Cultural Affairs, New Delhi). 544p.

Proceedings of the Summer School of Theoretical Physics held at Mussoorie, India, May 22 to June 18, 1959, are presented. The 50 papers are grouped under the following headings: field theory, nuclear physics, strange particles, showers, statistical mechanics, chemical physics, astrophysics and magnetohydrodynamics, and selected topics. Separate abstracts were prepared for 40 papers. One was previously abstracted for NSA. (M.C.G.)

18165 (NP-11463(Pt.1)(p.1-13)) PERTURBATION EXPANSIONS AND KERNEL FUNCTIONS ASSOCIATED WITH SINGLE PARTICLE WAVE FUNCTIONS. Alladi Ramakrishnan and R. Vasudevan (Madras. Univ.).

The treatment of perturbation theory in kernel function formalism was applied to wave functions. The Feynman formulation as a natural consequence of a re-examination of the "old-fashioned" perturbation theory was examined. An extension was made of the perturbation theory to Dirac particles. Starting with $R_{nm}(K)$ which represents the happenings at vertices K, the Feynman propagators were arrived at by suitably collecting the $\bar{\psi}_n$ and ψ_m functions in the usual expansion for the solution of a differential equation. (M.C.G.)

18166 (NP-11463(Pt.1)(p.15-18)) QUANTUM MECHANICS OF THE PHOTON. Alladi Ramakrishnan (Madras. Univ.).

The equation of motion of the photon is discussed from the point of view of wave functions. The quantum theory relation of energy of the photon to the frequency of the electromagnetic field corresponding to it and the Lorentz invariant free field Maxwell's equations were used to determine the wave function. It is shown that by making use of the wave function of the photon, a given electromagnetic field can be adequately described. (M.C.G.)

18167 (NP-11463(Pt.1)(p.19-26)) QUANTUM FIELD THEORY IN HEISENBERG PICTURE. Gyan Mohan (India. National Physical Lab., New Delhi).

A study was made of the structure of the quantum field theory in terms of operators and state vectors in the

Heisenberg picture. The observable quantities are expressed in terms of the Heisenberg fields. The vacuum expectation value of T-products of Heisenberg fields was studied. Renormalization in the quantum field theory was also investigated. (M.C.G.)

18168 (NP-11463(Pt.1)(p.27-32)) ACCELERATION TRANSFORMATIONS. Vachaspati (Lucknow, India. Univ.).

A search was made for the possible coordinate transformations that leave the various equations of physics invariant. The case of the massless real scalar wave equation was examined. Under transformations developed for this case, the scalar product of two vectors was not invariant. Only the angles between vectors were preserved, not the magnitude. (M.C.G.)

18169 (NP-11463(Pt.1)(p.33-9)) DISPERSION RELATIONS IN QUANTUM FIELD THEORY. Sarbeshwar Acharya (Ravenshaw Coll., Cuttack, India).

The development of dispersion relations is discussed. It was previously suggested that dispersion relations may be obtained by invoking the causality requirements. An analysis of this requirement imposes certain restrictions on the matrix elements of the S-matrix from which the dispersion relations follow either by the application of the Cauchy integral theorem or by a theorem due to Titchmarsh. This is demonstrated by considering the situation where the quantized electromagnetic field interacts with a quantized matter field. The work was carried out in the Heisenberg picture and switched to the interaction picture for practical application. (M.C.G.)

18170 (NP-11463(Pt.1)(p.41-8)) ON THE CONNECTION BETWEEN SPIN AND STATISTICS. P. K. Kabir (Calcutta. Univ.).

It is demonstrated that non-classical statistics follow the general principles of quantum mechanics. The correlation between spins of particles and the statistics obeyed by them is discussed. The case of a neutral spin-zero particle represented by the Hermitian scalar field $\Phi(x)$ is considered in the Heisenberg field so that the effect of all interactions in included in the field operators. (M.C.G.)

18171 (NP-11463(Pt.1)(p.49-52)) NUCLEON-ANTINUCLEON SCATTERING. A. N. Mitra and R. P. Saxena (Aligarh Muslim Univ., Aligarh, India).

The problem of nucleon interactions with antinucleons was investigated in the framework of pseudoscalar meson theory by applying the New Tamm-Dancoff approximation developed by Dalitz and Dyson. The complete integral equation for the $(N\text{-}\bar{N})$ system was obtained. The equation was then solved only for the annihilation interaction. It was observed that renormalization played a vital role in bringing about the right order of magnitude for the N-N cross section. The charge-exchange scattering reaction was found to be about 10 to 15% of the total process. (M.C.G.)

18172 (NP-11463(Pt.1)(p.57-70)) POLARIZATION PHENOMENA IN BREMSSTRAHLUNG. H. Banerjee (Indian Inst. of Tech., Kharagpur).

An investigation was made of polarization effects in bremsstrahlung. The polarization formalisms for photons and electrons are given. Results are presented of polarization effects in integrated bremsstrahlung cross section. The effects of screening and multiple scattering on bremsstrahlung polarization were determined. (M.C.G.)

18173 (NP-11463(Pt.1)(p.71-4)) ON THE SOLUTION OF DIRAC EQUATION IN THE FIELD OF ELECTROMAGNETIC RADIATION AND THE SCATTERING OF ELECTROMAGNETIC RADIATION BY FREE ELECTRON. N. D. Sen Gupta (Bombay. Univ. Ramnarain Ruia Coll.).

The solution of the Dirac equation, calculation of scattering of electromagnetic waves by free electrons, Klein Nishina formula for Compton effect, and solution of Dirac equation in the field of electromagnetic radiation are presented. (M.C.G.)

18174 (NP-11463(Pt.1)(p.75-117)) THE BRUECKNER THEORY OF THE NUCLEUS. Ajit Kuman Saha (Saha Inst. of Nuclear Physics, Calcutta).

The basic aspects of the Brueckner theory of the nucleus are reviewed. Goldstone's presentation of the Brueckner linked cluster expansion is given. The Goldstone formulation was applied to derive the Hartree-Fock method. The meaning of the reaction matrix in Brueckner's theory is explained. The self-consistency cycle in the Brueckner Theory, the Hugenholtz and Van Hove theorem, and the density dependence of different terms of the energy expansion are discussed. (M.C.G.)

18175 (NP-11463(Pt.1)(p.119-32)) APPLICATION OF BRUECKNER THEORY. Suprokash Mukherjee (Saha Inst. of Nuclear Physics, Calcutta).

The application of Brueckner's theory to the problems of nuclear matter is discussed. The parameters characterizing nuclear matter are given. The case of two particles in a Fermi sea interacting with hard core potential alone is considered. It was determined that nucleons do show a high degree of correlated motions inside a nucleus but the correlation distance is short so that beyond that distance their motions seem to be uncorrelated. Factors contributing to the validity of the independent particle approximation are enumerated. The results of Brueckner and Gammel's calculation of the properties of nuclear matter are given. (M.C.G.)

18176 (NP-11463(Pt.1)(p.133-7)) PHENOMENOLOGICAL CONSIDERATIONS AND A SIMPLE APPROACH TO THE NUCLEAR SELF-CONSISTENT FIELD PROBLEM. N. V. V. J. Swamy.

Evidence showing that the shell model nuclear potential should have a diffuse boundary rather than a sharp edge as in the case of a square well is discussed. Green's studies showed that the particle binding energies are very sensitive to the diffuseness parameter. The proton potential anomaly is described. Studies of the nuclear self-consistent field problem by Talman are outlined. Results obtained by Talman were studied to determine the effects of using phenomenological densities obtained by Green in zero-stage calculation instead of a rectangular distribution. (M.C.G.)

18177 (NP-11463(Pt.1)(p.139-47)) THE NUCLEAR SHELL MODEL: A REVIEW. S. P. Pandya (Physical Research Lab., Ahmedabad, India).

The basic physical concepts of the shell model are reviewed. The uses of the shell model in calculating nuclear properties are described. Degeneracy of nuclear states in the shell model is discussed. Geometrical theorems for nuclear properties of related nuclei based on general assumptions within the framework of the shell model were developed. (M.C.G.)

18178 (NP-11463(Pt.1)(p.149-58)) CORRELATIONS IN THE WAVE FUNCTION OF THE Ca^{42} NUCLEUS. B. Dutta Roy (Saha Inst. of Nuclear Physics, Calcutta).

Correlations in the wave function of Ca^{42} nucleus are discussed on the basis of the shell model and the Brueckner theory. The Gammel-Thaler potential was used in the calculation. The energies of the various total angular momentum states were determined. The calculations were made in the following steps: not including non-local effects, including non-local effects, and including configuration

mixing. The effects on the energy level separations of the short- and long-ranged correlations are shown. (M.C.G.)

18179 (NP-11463(Pt.1)(p.159-69)) STRIPPING TYPE NUCLEAR REACTIONS. M. A. Nagarajan (Saha Inst. of Nuclear Physics, Calcutta).

Studies of stripping reactions are described. The treatment of Tobocman was followed in deriving the expression for the stripping amplitude. The effects of exchange in stripping reactions were studied and incorporated into the theory of angular distributions by taking antisymmetrized wave functions for the initial or final state. Expressions were obtained for the direct and exchange stripping cross sections in the LS- and jj-coupling schemes. The theory was developed for a nucleus containing more than one particle outside a closed shell. (M.C.G.)

18180 (NP-11463(Pt.1)(p.171-4)) SPIN-ORBIT EFFECTS IN CERTAIN LOW ENERGY NUCLEAR PHENOMENA. A. N. Mitra (Aligarh Muslim Univ., Aligarh, India).

The effects of spin-orbit forces on certain low-energy phenomena were examined. The contribution of the spin-orbit term to the magnetic moment of the deuteron was determined. Spin-orbit energy splitting in O^{17} and Ca^{41} was also studied. (M.C.G.)

18181 (NP-11463(Pt.1)(p.175-8)) ANGULAR CORRELATIONS. R. Vasudevan (Madras. Univ.).

A study was made of angular correlation based on the angular momentum theory. The direction and distributions of several radiations with respect to each other were studied for definite states of momentum and parity. Three methods of determining angular correlations are described. (M.C.G.)

18182 MICROWAVE DISCHARGE PRODUCTION OF HYDROGEN ATOMS. CONTROL OF HYDROGEN ATOM QUANTITY PRODUCED. Boerge Bak and John Rastrup-Andersen (Universitet, Copenhagen). Acta Chem. Scand., 16: 111-16(1962). (In English)

The production of hydrogen (and deuterium) atoms by a microwave discharge is described. Three different methods of estimating the quantity of atoms produced were tested: a hotwire detector, a thermometric detector, and a chemical, luminescent detector. Application of each of the three types of indicator is useful in various phases of experimental work. (auth)

18183 THERMOELECTRICITY APPLICATION CONSIDERATIONS. A. A. Sorensen (Martin Co., Baltimore). Applications and Ind., No. 57, 285-9(Nov. 1961).

The characteristics, limitations, and advantages of using thermoelectric cells and materials are discussed from the engineering design point of view. Information is presented in a manner such that equipment may be designed around limitations and exploit advantages. (N.W.R.)

18184 DIRECT CONVERSION OF NUCLEAR FISSION ENERGY INTO ELECTRICAL ENERGY. K. H. Beckurts and K. Schretzmann (Institut für Neutronenphysik und Reaktortechnik, Karlsruhe, Ger.). Atomwirtschaft, 7: 69-74(Feb. 1962). (In German)

Various principles, technical mechanisms, present state of development, and future prospects for the direct conversion of nuclear fission energy into electrical energy are described in detail. The three most promising processes for the direct conversion of heat into electricity are presently the thermoelement, the thermionic converter, and the magneto-hydrodynamic (MHD) generator. In the case of thermoelements special conversion devices using semiconductor elements are already being applied. Thermionic converters have predominantly utilized up to now the mechanism of the vacuum diode. In the MHD conversion method the fission energy is used to heat a gas which is subsequently expanded in the presence of a magnetic field. (P.C.H.)

18185 THE OPERATION OF CRYSTAL COUNTERS WITH NON-UNIFORM ELECTRIC FIELD DISTRIBUTION. K. N. R. Taylor (Univ. of Durham, Eng.). Brit. J. Appl. Phys., 13: 242-4(May 1962).

A simple theoretical analysis of the magnitude of bombardment conductivity pulses produced in a Schottky type exhaustion barrier is carried out. For the energetic particles incident on the crystal normal to the field direction, the variations of pulse size with position of incidence in the barrier and with applied voltage are found. The case of incidence parallel to the field direction is also considered. Comparison with experiment for zinc sulfide crystals shows good agreement with the predicted results, and values of the electron lifetime and donor concentration are obtained. (auth)

18186 A PARTICLE AT REST IN A STATIC AXIALLY SYMMETRIC GRAVITATIONAL FIELD. N. Rosen and D. Yaakobi (Israel Inst. of Tech., Haifa). Bull Research Council Israel, Sect. F., 10: 49-52(Dec. 1961). (In English)

The equations of Weyl and Levi-Civita for a static axially symmetric field are written in spherical polar coordinates, and a general solution describing a particle in an external field is obtained. The condition that there be no singularities on the axis except at the particle is equivalent to the requirement that in the corresponding Newtonian case, the force on the particle vanish. (auth)

18187 A QUADRUPOLE MOMENT IN A STATIC AXIALLY SYMMETRIC METRIC. Daniel Yaakobi (Israel Inst. of Tech., Haifa). Bull. Research Council Israel, Sect. F., 10: 69-73(Dec. 1961). (In English)

A static, axially-symmetric line element satisfying the Weyl and Levi Civita equations is compared with the Schwartzschild metric when both line elements satisfy the same standard conditions. The axial symmetric line element possesses a mass quadrupole moment. (auth)

18188 THE EFFECT OF STAGING ON THE PERFORMANCE OF THERMIONIC CONVERTERS. George N. Hatsopoulos (Massachusetts Inst. of Tech., Cambridge). Commun. and Electronics, No. 59, 36-40(Mar. 1962).

Staging of thermionic converters improves the over-all efficiency of the system. For the case of zero space charge, the efficiency of a stage may approach $0.5\ \Delta T/T$ as ΔT approaches zero, using available materials. When large numbers of stages are used, an optimum work function exists for the electrodes. The optimum work function strongly depends on temperature. At low temperatures, the optimum work function is lower than those of available materials and is insignificant. (auth)

18189 ELECTRICAL CONDUCTIVITIES OF AIR IONIZED BY SHOCK-WAVES. Pierre Valentin. Compt. rend., 253: 215-17(July 10, 1961). (CEA-2063) (In French)

Results are given of measurements made, using electrodes, of the conductivity of air ionized by shock-waves in a shock tube. For low and high wave velocities, two very different conductivity profiles behind the wave were obtained. The measured conductivities were compared with the theoretical values. (auth)

18190 INFLUENCE OF A DIPOLAR FIELD ON THE NUCLEAR RESONANCE OF IRON-57 IN AN IRON–YTTRIUM GARNET. Françoise Boutron and Claude

Robert. Compt. rend., 253: 433-5(July 17, 1961). (CEA-2042) (In French)

The existence of a dipolar magnetic field at the Fe^{3+} ion level in an iron–yttrium garnet makes it possible to explain the structure and the width of the nuclear resonance lines of Fe^{57} nuclei observed on the 16 a sites. (auth)

18191 SINGULARITIES OF JOST FUNCTIONS AND POTENTIALS. M. Petráš (Komensky Univ., Bratislava, Czechoslovakia). Czechoslov. J. Phys., 12: 87-92(1962). (In English)

The possibility of determining a potential from given singularities of Jost functions is investigated. It is proved that for N poles the problem can be reduced to the solving of a system of N linear nonhomogeneous equations, and that for the case of discontinuities along a cut to the solving of a nonhomogeneous integral equation. The potentials obtained are a superposition of exponential potentials. (auth)

18192 STUDY ON SOME SCINTILLATING GLASSES. G. Bertozzi, C. Coeceva, and S. Pizzini (CNEN, Ispra, Italy). Energia nucleare (Milan), 9: 164-7(Mar. 1962). (In English)

Scintillation properties of lithium borosilicate cerium activated glasses are considered. Measurements of transmittance, excitation, fluorescence spectra, and pulse height distribution under thermal neutron irradiation are reported along with some considerations on the influence of B_2O_3 content on the scintillation properties. (auth)

18193 SPACE WITH TORSION AND NON-LINEAR FIELD EQUATIONS. V. I. Rodichev (Moscow Region Pedagogical Inst.). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 6, 118-25(1961). (In Russian)

It is shown that in a space with torsion the nonlinear spinor equations of Heisenberg-Ivanenko type result from a variation principle in which the Dirac Lagrangian is supplemented by scalar space curvature. (tr-auth)

18194 CLUSTER THEORY OF SATURATED VAPOR OF HELIUM–ISOTOPE MIXTURES. Richard O. Adams (Washington State Univ., Pullman), William Band, Glenn R. Ingram, and Clay L. Perry. J. Chem. Phys., 36: 1703-6 (Apr. 1, 1962).

The quantum statistical cluster model of the saturated vapor of mixtures of helium isotopes He^3 and He^4 was subjected to a program on an electronic digital computer. The results permit a prediction of the saturated-vapor density as a function of the mixture concentration for each of the isotherms given by experimental data on the saturated vapor pressure of the same mixtures. (auth)

18195 ENHANCEMENT OF RARE-EARTH ION FLUORESCENCE BY LATTICE PROCESSES IN OXIDES. L. G. Van Uitert, R. R. Soden, and R. C. Linares (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 36: 1793-6(Apr. 1, 1962).

In the absence of a suitable absorption band for a rare earth ion, its fluorescence can be excited by ultraviolet radiation through interaction with the host lattice when the latter is excited near its absorption edge. Rare earth ion fluorescence can be enhanced by localized lattice processes at frequencies lower than the absorption edge. Longer range effects occur as the absorption region of the crystal is approached. The enhancement due to these processes can be quenched by effects resulting from an increase in rare earth ion content. (auth)

18196 EFFECTS OF RARE-EARTH ION SUBSTITUTION UPON THE FLUORESCENCE OF TERBIUM HEXA-ANTIPYRENE TRI-IODIDE AND SODIUM EUROPIUM TUNGSTATE. L. G. Van Uitert and R. R. Soden (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 36: 1797-1800(Apr. 1, 1962).

The directions and relative ease of transfer of energy between different rare earth hexa-antipyrene aggregates are compared by examining the influences of rare earth substitutions upon the fluorescence of terbium hexa-antipyrene tri-iodide. Data concerning much shorter range interactions between rare earth ions are obtained employing the sodium rare earth tungstates. Energy transfer and quenching effects show systematic relationships to the total orbital angular momentum of the 4f subshell electrons of the rare earth ions. (auth)

18197 APPLICATION OF RAYLEIGH-SCHRÖDINGER PERTURBATION THEORY TO THE HYDROGEN ATOM. B. F. Gray (Royal Coll. of Advanced Tech., Salford, Eng.). J. Chem. Phys., 36: 1801-3(Apr. 1, 1962).

A complete solution to all orders of perturbation theory is obtained without recourse to numerical approximation and it is shown that all corrections to the energy of higher order than the second do in fact vanish although the corrections to the wave function do not. (auth)

18198 INTERACTION ENERGIES FROM SCATTERING CROSS SECTIONS OF HYDROGEN IONS IN CH_4, CF_4, C_2H_6, AND C_2F_6. Robert D. Cloney and Joseph T. Vanderslice (Univ. of Maryland, College Park). J. Chem. Phys., 36: 1866-9(Apr. 1, 1962).

Potential energy curves for the interactions between hydrogen ions (H^+, H_2^+) and CH_4, C_2H_6, CF_4, and C_2F_6 were determined from previously determined elastic scattering cross section measurements. The scattering measurements indicate no minimum in the $H^+ - CH_4$ potential curve as might be expected from the fact that mass spectrographic results indicate a proton affinity of 5 ev for CH_4. Reasons are suggested why no minimum is indicated. Various crude semiempirical schemes are suggested for correlating the potential curves for the different interaction systems. All suggested schemes were tested on the experimental results and were found to reproduce the measured potentials to within a factor of 2. (auth)

18199 ABSORPTION AND FLUORESCENCE SPECTRA OF Pr^{3+} IN $LaBr_3$. Eugene Y. Wong and Isaac Richman (Univ. of California, Los Angeles). J. Chem. Phys., 36: 1889-92(Apr. 1, 1962).

Absorption and fluorescence spectra of 1 and 10% Pr^{3+} in $LaBr_3$ were observed and an analysis carried out. The energy levels of the Pr^{3+} ions are very similar to Pr^{3+} in $LaCl_3$, except that the centers of the J levels differ on the order of 10^2 cm^{-1}. This corresponds to a change in Slater integrals of 0.5%. This change must be attributed to the different ligands in the two crystals. Two explanations are proposed, one based on a pure ionic model and the other on a model with small covalent bonding. (auth)

18200 SHOCK-TUBE MEASUREMENT OF DISSOCIATION RATES OF HYDROGEN. Richard W. Patch (United Aircraft Corp. Research Labs., East Hartford, Conn.). J. Chem. Phys., 36: 1919-24(Apr. 1, 1962).

The rate of dissociation of hydrogen was measured in a shock tube by following the absorption of ultraviolet light by the H_2 $^1\Pi_u - {}^1\Sigma_g^+$ Werner transition. Dissociation was observed in mixtures of from 1.00 to 30.1% hydrogen over the temperature range from 2950 to 5330°K. A digital computer program was used to calculate reaction profiles behind a normal shock wave for arbitrary reaction rate coefficients assuming that the reaction proceeded by the mechanism $H_2 + M \underset{k_r}{\overset{k_d}{\rightleftharpoons}} 2H + M$, where the third body, M, may be Ar, H_2, or H. By varying the reaction rate coefficients, it was possible to match the computed reaction pro-

files with the observed profiles for all experiments; however, the temperature range covered was not sufficiently wide to permit an accurate determination of the temperature dependence of k_r. Consequently, a T^{-1} dependence was arbitrarily chosen. The recombination rate coefficients in cm^6 $mole^{-2}$ sec^{-1} were 7.5×10^{17} T^{-1} for argon as the third body, 7.5×10^{18} T^{-1} for H_2, and 5×10^{19} T^{-1} for H, where T is in °K. (auth)

18201 THE DISTANT GEOMAGNETIC FIELD. 1. INFINITESIMAL HYDROMAGNETIC WAVES. C. P. Sonett (National Aeronautics and Space Administration, Washington, D. C.) and A. R. Sims and I. J. Abrams. J. Geophys. Research, 67: 1191-1207(Apr. 1962).

The presence of magnetoacoustic, mixed (oblique), and transverse hydromagnetic waves is demonstrated at geocentric distances of 3.7 to 7 earth radii on the sunlit hemisphere. The frequencies present extend to 13 radians/sec, which is the upper cutoff for the passband of the magnetometer used in this experiment. The mixed mode is identified with the ordinary transverse (Alfvén) wave, and the pure transverse mode with the extraordinary wave. The power spectra display discrete lines from which coupling of modes can be deduced. Typical wave energy densities vary from 10^{-13} to 10^{-12} erg/cm^3 over 1 cps. On the assumption that the available sample typifies the magnetospheric volume to 7 geocentric radii, the hydromagnetic radiation energy appears to be of the order of 10^{18} ergs over 1 cps. At a mean hydromagnetic velocity of 3×10^7 cm/sec and assuming that all this radiation was entrant upon the ionosphere, the energy input would be some 10^{-5} erg/cm^2 sec between 0 and 1 cps. In addition to many discrete lines in the spectra, there is continuum radiation. Finite line width provides a measure of broadening possibly due to positive ion Landau dumping. The spectra suggest excitation of the far magnetosphere. (auth)

18202 THE OCCURRENCE OF AURORA IN GEOMAGNETICALLY CONJUGATE AREAS. R. N. DeWitt (Geophysical Inst., College, Alaska). J. Geophys. Research, 67: 1347-52(Apr. 1962).

A study of several nights of IGY all-sky camera data indicated that auroras occur simultaneously in geomagnetically-conjugate areas. The conjugate auroras are highly correlated in their variations of luminosity and show striking similarities in form and motion. (auth)

18203 MAGNETIC ACTIVITY DURING PERIODS OF AURORAS AT GEOMAGNETICALLY CONJUGATE POINTS. Eugene Wescott (Geophysical Inst., College, Alaska). J. Geophys. Research, 67: 1353-5(Apr. 1962).

The magnetic variations at geomagnetically-conjugate Kotzebue, Alaska, and Macquarie Island were studied during two days in March 1958, when auroras occurred simultaneously and in similar forms in conjugate areas. The correlation of the variations in H and D at the conjugate stations during the periods of auroras and the rest of the time studied is very good. This supports the theory that, at least during certain periods, ionospheric events in the northern and southern hemispheres are closely linked by the magnetic field lines. (auth)

18204 POLAR-CAP ABSORPTION AND THE MAGNETIC STORM OF FEBRUARY 11, 1958. W. I. Axford and G. C. Reid (Defence Research Board, Ottawa). J. Geophys. Research, 67: 1692-6(Apr. 1962).

For 12 hr preceding the storm, polar-cap absorption indicated a flux of actinic radiations at 10 to 100 Mev near the earth. A solar flare of 2^+ importance produced the storm. Effects on energetic particles near the earth are discussed. Cosmic-noise absorption was recorded using high-latitude riometers. Data are presented in graphical form. (L.N.N.)

18205 THREE-COMPONENT SPINORS. Asher Peres (Israel Inst. of Tech., Haifa). J. Math. and Mech., 11: No. 1, 61-79(Jan. 1962).

It is shown that traceless symmetric tensors correspond to hermitian second-rank 3-spinors. Fourth and higher-rank tensors correspond to higher-rank 3-spinors. Results are applied to Rainich's theorem in electromagnetic theory and to investigations of the Riemann curvature tensor algebraic invariants in general relativity. (I.N.N.)

18206 A SUBLINEAR STURM LIOUVILLE PROBLEM. George H. Pimbley, Jr. (Los Alamos Scientific Lab., N. Mex.). J. Math. and Mech., 11: No. 1, 121-38(Jan. 1962).

The classical linear regular Sturm-Liouville problem formulates existence of a pure discrete point spectrum lying on the real axis, each eigenvalue being of index 1 and of finite multiplicity, and a corresponding system of finite dimensional eigenvalues, the finished product comprising the complete Hilbert space. This situation is disrupted by introducing a nonlinearity. (L.N.N.)

18207 SOME HYDROMAGNETIC EQUILIBRIA THAT SATISFY THE NECESSARY AND SUFFICIENT STABILITY CONDITIONS. D. M. Copley and K. J. Whiteman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 103-10(Apr. 1962). (In English)

A criterion that is both necessary and sufficient for the stability of a cylindircally symmetric hydromagnetic equilibrium was obtained by Newcomb and Suydam. A numerical method of using the criterion to test for stability is described, and stable equilibrium configurations are presented. (auth)

18208 HYPERFINE STRUCTURE AND ISOTOPE SHIFT IN THE $7\ ^2S_{1/2}-6\ ^2P_{1/2}$ TRANSITION OF NATURAL THALLIUM BY ATOMIC BEAM ABSORPTION. C. J. Schuler, M. Çiftan, L. C. Bradley, III, and H. H. Stroke (Massachusetts Inst. of Tech., Cambridge). J. Opt. Soc. Am., 52: 501-3(May 1962).

The isotope shift in the $7\ ^2S_{1/2}-6\ ^2P_{1/2}$ transition (3776Å) and the hyperfine-structure separations of Tl^{203} and Tl^{205} in the $7\ ^2S_{1/2}$ state were determined spectroscopically by atomic beam absorption using a Fabry-Pérot interferometer crossed with a 10-in. diffraction grating. Results are: 0.0554 ± 0.0012 cm^{-1} for the isotope shift in the 3776Å line; -0.0405 ± 0.0013 cm^{-1} in the $6\ ^2P_{1/2}$ level; and $\Delta\nu\ (7\ ^2S_{1/2}) = 0.4078 \pm 0.0014$ cm^{-1} and 0.4109 ± 0.0012 cm^{-1} for the hyperfine-structure separation in Tl^{203} and Tl^{205}, respectively. (auth)

18209 ENERGY LEVELS OF Er II. B. R. Judd and L. C. Marquet (Univ. of California, Berkeley). J. Opt. Soc. Am., 52: 504-7(May 1962). (UCRL-9830)

Eight low-lying levels of Er II $4f^{12}$ 6s were grouped according to energy in four close pairs. The centers of gravity of the pairs correspond to the energies of the four lowest levels of the core $4f^{12}$; the spacings between the two components of the pairs depend on the Coulomb interaction between the s electron and core and are determined by the single Slater integral $G^3(4f,6s)$. The levels of the core can be fitted very closely with integrals $F_k(4f,4f)$ whose ratios one to another are the same as those for a hydrogenic 4f eigenfunction. The integral $F_2(4f,4f)$ is 427 cm^{-1} and ζ_f the spin-orbit coupling constant, 2237 cm^{-1}. The spacings are fitted by a value of

1580 cm^{-1} for G^3; discrepancies are ascribed to configuration interaction. The g values of the levels agree with those calculated on the basis of perfect Jj coupling. (auth)

18210 PRIMARY STANDARD OF LENGTH. K. M. Baird and D. S. Smith (National Research Council, Ottawa). J. Opt. Soc. Am., 52: 507-14(May 1962).

The primary standard of length is defined in terms of the unperturbed $2p_{10}-5d_5$ radiation of Kr^{86}. New measurements of the perturbations due to the conditions of excitation necessary for its practical realization are reported. Results confirm that the recommendation of the International Committee of Weights and Measures yields the defined standard to an accuracy of better than $1:10^9$. An improvement by about an order of magnitude may be realized by more exact specifications. (auth)

18211 EXPERIMENTAL VERIFICATION OF THE RELATIVISTIC DOPPLER EFFECT. Hirsch I. Mandelberg and Louis Witten (RIAS, Baltimore). J. Opt. Soc. Am., 52: 529-36(May 1962).

An experiment was performed to measure the quadratic Doppler shift, $\sim(1-v^2/c^2)^{-1/2}$, predicted by the special theory of relativity. A moving beam of radiating hydrogen atoms with velocities ranging up to 2.8×10^8 cm/sec was viewed from the incoming and outgoing directions, simultaneously. Averaging wavelength measurements of a particular spectral line gives a measurement of the quadratic shift. The number ($1/2$) in the theoretically predicted exponent can be compared to the experimental results. The latter gives the value of this exponent to be 0.498 ± 0.025. The predominant factor leading to the experimental uncertainty is the width of the spectral lines involved. (auth)

18212 AN SCF–LCAO–MO STUDY OF H_2^+ AND H_2. Vincent DeCarlo and Virginia Griffing (Catholic Univ. of America, Washington, D. C.). J. Phys. Chem., 66: 845-9 (May 1962).

A variational calculation of the electronic energy of H_2^+ as a function of the distance between the nuclei was carried out using 1s, 2s, and 2p Slater-type orbitals on each atom. The exponential factor was chosen to be the same for all of the basis functions, but this factor was varied as a parameter in the variational calculations. The results obtained in this way are compared with previous calculations on H_2^+. By increasing the basis set and varying the exponential factor, the energy of H_2^+ converges toward the known exact solution. The best basis set for H_2^+ then was shown to give the best results in a self-consistent field calculation on the H_2 molecule. The energy of H_2^+ calculated from the H_2 molecule calculations using Koopman's theorem were not quite as good as the direct H_2^+ ion calculations. (auth)

18213 EFFECT OF THE p-Ag DURING THE PREPARATION OF AN IONOGRAPHIC EMULSION ON THE GRAIN DIAMETER. F. Simon (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 792-4 (Dec. 1961). (In French)

The results obtained for the preparation of nuclear emulsions with excess of silver ions under certain conditions of precipitation are given. The values of p-Ag determined are compared with data given in other works. The most favorable values of p-Ag for obtaining very fine and homogeneous grains are defined. (auth)

18214 HIGHER ORDER CORRECTION TO SCREENING CONSTANT. Yukio Ôsaka (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 17: 547-65(Mar. 1962). (In English)

An evaluation is carried out for correcting the screening constant and the dispersion coefficient for the plasmon energy in a degenerate electron gas without using the high density approximation. Contributions of diagrams consisting of all possible combinations of "exchange self energy" to the low temperature specific heat are computed. The exchange effect of the effective interaction has little effect on the low temperature specific heat, and higher order diagrams in the "ladder interaction" contribute appreciably to the screening constant. The correction factor for the dispersion coefficient of the plasmon energy is larger than unity for $r_s > 1$, and the convergence of high density expansion is slow, especially for the exchange effect of the effective interaction. Results obtained by using the high density approximation overestimate the exchange effect. (auth)

18215 STEADY TWO-DIMENSIONAL CHANNEL FLOW OF AN INCOMPRESSIBLE PERFECT FLUID WITH SMALL ELECTRIC CONDUCTIVITY IN THE PRESENCE OF NONUNIFORM MAGNETIC FIELDS. Takeo Sakurai and Makoto Naito (Kyoto Univ.). J. Phys. Soc. Japan, 17: 675-81 (Apr. 1962). (In English)

The steady two-dimensional channel flows of an incompressible perfect fluid with small electric conductivity in the presence of nonuniform magnetic fields generated by a system of electric currents and magnetic poles are considered. The flow and the magnetic fields are calculated for small values of electric conductivity of the fluid. The velocity distribution depends, within the order of the approximation, only on the distribution of the magnitude of the magnetic field. The numerical calculations are performed for one case of the geometrical parameter which represents the position of the currents or of the magnetic poles, and the results are shown graphically. The analytical expressions for the pressure difference between infinities down- and upstream and the velocity distribution at the infinity downstream are presented. (auth)

18216 LINEARIZED THEORY OF CONDUCTING TWO-DIMENSIONAL GAS FLOW IN TRANSVERSE MAGNETIC FIELD. Shigenori Ando (Kawasaki Aircraft Co., Japan). J. Phys. Soc. Japan, 17: 686-91(Apr. 1962). (In English)

The interaction between the two-dimensional flow past a thin airfoil and the magnetic field perpendicular to the plane of flow is studied using the fundamental equations (S. Ando in J. Phys. Soc. Japan 15: 1523(1960)). When the magnetic Reynolds number is infinite, the space current pattern is constructed using a stream function. When the magnetic interaction is weak, the situation is similar to that of the aligned field case except for the wake running rearward in the subsonic flow. (auth)

18217 A CHARACTERISTIC OF THE P.I.G. TYPE DISCHARGE TUBE. Yuji Tanaka and Kenzo Yamamoto (Nagoya Univ., Japan). J. Phys. Soc. Japan, 17: 715 (Apr. 1962). (In English)

A plot of the tube potential drop versus the magnetic field is presented. Plasma behavior at various points is described. Tube characteristics and dimensions are given. (L.N.N.)

18218 DOES MATTER HAVE A HALF-LIFE? E. R. Swart (University Coll. of Rhodesia and Nyasaland, Salisbury, Southern Rhodesia). Nature, 194: 464(May 5, 1962).

It is shown that there is no reason why the confirmation or disproof of the suggestion that atoms of matter disappear spontaneously in a statistically random manner with a half life of about 4×10^9 years and that it is the extinction of matter which causes gravitational attraction should not be established by means of existing techniques. The three main difficulties of existing techniques are given. However, it is felt that if an apparatus with sufficient sensitivity and speed of response can be constructed, it should be

possible, by an analysis of the frequency and magnitude of apparent variation in G, not only to verify that matter does have a half life but to estimate the magnitude of such a half life as well. (P.C.H.)

18219 THE CALCULATION OF EFFECTIVE CUTOFF ENERGIES IN CADMIUM, SAMARIUM, AND GADOLINIUM. G. D. Hickman and W. B. Leng (Knolls Atomic Power Lab., Schenectady, N. Y.). Nuclear Sci. and Eng., 12: 523-31 (Apr. 1962).

A set of effective cutoff energies for 1/v detectors covered by cadmium, samarium, and gadolinium filters is presented. These cutoff energies were calculated for both isotropic and beam fluxes which were made up of a Maxwellian thermal plus a 1/E tail. Calculations were performed as a function of r (the ratio of thermal flux to the resonance flux per unit lethargy), E_M (the Maxwellian neutron energy), and the absorption coefficients of the 1/v foil and the resonance filter. The cutoff energies for samarium were found to be appreciably lower than those for cadmium, while those for gadolinium, especially for thicknesses of 30 to 40 mils, are similar to those of cadmium. It is felt that these rare earth filters might be able to supply valuable information in the region of low cutoff energies, especially in high temperature facilities where cadmium with its low-melting point is difficult to use. (auth)

18220 DETERMINATION OF THE S MATRIX IN THE CASE OF TENSOR POTENTIALS NON ZERO AT THE ORIGIN. H. Cornille (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). Nuovo cimento (10), 23: 526-36(Feb. 1, 1962). (In French)

The "Jost functions" are determined in non-relativistic quantum mechanics by considering a basic set of solutions defined by their incoming or outgoing asymptotic behavior. It is demonstrated that in the coupled case where tensor potentials satisfy $V_T(0) \neq 0$ it becomes difficult to apply the regularity conditions to the physical solutions, which are linear combinations of the basic set. The usual process for extracting the singular part at r = 0 allows removal of only one of the two singular solutions. In certain cases, the contribution of the less singular solution may be obtained by using a finite expansion of the more singular solution; the regularity conditions are satisfied. (auth)

18221 MIE'S ELECTRODYNAMICS WITHOUT POTENTIALS. A. H. Klotz (Rutherford Coll. of Tech., Newcastle-upon-Tyne, Eng.). Nuovo cimento (10), 23: 697-701(Feb. 16, 1962). (In English)

It is shown that Mie's theory of electromagnetism can be formulated without an explicit use of the four-vector potential functions along the lines developed by Infeld and Plebanski (Proc. Roy. Soc., 224: 222(1954)). A general form of the relationship between Mie's quantitative functions and the electromagnetic intensities is suggested. (auth)

18222 LUMINESCENCE OF KI UNDER X-RAY IRRADIATION. R. Fieschi and G. Spinolo (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Nuovo cimento (10), 23: 738-50(Feb. 16, 1962). (In English)

The x-ray induced luminescence of KI was investigated at 200 to 600 nm, at −180 to 80°C. Changes in the intensity and spectral distribution of the luminescence are studied, as a function of the irradiation time, and under the influence of plastic deformation, additive coloration, and heat treatments. Heating in vacuum induces a 400-nm emission band, which is practically absent in "as received" crystals; plastic deformation and heating in air enhances the 515-nm emission band, otherwise very weak. The dependence of intensity on the x-ray dose and the consequences of various heat treatments suggest that the 515-nm emission is due to a color center associated with an oxygen impurity. (auth)

18223 POTENTIAL REPRESENTATION IN QUANTUM FIELD THEORY. H. Ezawa, K. Kikkawa, and H. Umezawa (Tokyo Univ.). Nuovo cimento (10), 23: 751-77(Feb. 16, 1962). (In English)

In the realm of quantum field theory, it is proved that the adiabatic theorem holds for vacuum and one-particle states. Using this theorem, a representation in which interactions vanish as particles go away from each other is constructed. In this sense, the interactions can be compared to the potential energies in quantum mechanics of particles. The interaction operator is similar but not identical to Heitler's reaction matrix. The use of the representation is illustrated by examining the scattering problems in Lee's model. (auth)

18224 OSCILLATOR STRENGTHS OF SPECTRAL LINES OF MAGNESIUM, STRONTIUM, AND BARIUM. N. P. Penkin and L. N. Shabanova. Optics and Spectroscopy (U.S.S.R.)(English Translation), 12: 1-5(Jan. 1962).

The oscillator strengths of 13 lines of the principal series of strontium and barium atoms were measured by the hook method. It was shown that the transition probabilities in the principal series of these atoms are a nonmonotonic function of the principal quantum number at the higher levels. The oscillator strengths of the MgI and SrI lines arising from the $^3P^0_{0,1,2}-{}^3S_1$ and $^3P^0_{0,1,2}-{}^3D_{1,2,3}$ transitions were determined, as well as those of SrI and BaI lines which are produced by the simultaneous excitation of two electrons. (auth)

18225 GAMMA AND PHOTOLUMINESCENCE OF ALKALI IODIDES. N. N. Vasil'eva and Z. L. Morgenshtern. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 41-4(Jan. 1962).

Gamma and photoluminescence of CsI and KI crystals were studied. Excitation spectra of the ultraviolet emission bands were measured. It is shown that these emission bands lie in the exciton absorption region and that activator luminescence is not excited in this region for the case of CsI–Tl. The nature of these alkali iodide luminescence bands is discussed. (auth)

18226 INFRARED LUMINESCENCE OF F-CENTERS IN X-RAYED FLUORITE CRYSTALS. I. I. Ezhik. Optics and Spectroscopy (U.S.S.R.)(English Translation), 12: 44-5 (Jan. 1962).

The temperature dependence of the infrared fluorescence intensity of x irradiated fluorite crystals was studied in the temperature interval from 77 to 680°K. It was found that the infrared luminescence had maxima at 110, 186, 225, 268, 292, 330, and 350°K. The maximum of the radiation band in the infrared fluorescence was determined by spectrometry. At liquid nitrogen temperature, it is located at 1.24μ. (auth)

18227 CALCULATION OF THE CROSS SECTION FOR FREE-FREE TRANSITIONS OF AN ELECTRON IN THE FIELD OF A NEUTRAL HYDROGEN ATOM. V. E. Romanov. Optics and Spectroscopy (U.S.S.R.)(English Translation), 12: 54-5(Jan. 1962).

The formula and values for the cross section of absorption for free-free transitions of an electron in the field of a neutral hydrogen atom are given. The results obtained agree with numerical calculations previously obtained by others to within an accuracy of 10 to 15%. (P.C.H.)

18228 CONSIDERATION OF STRONG COUPLING IN COLLISIONS OF ELECTRONS WITH HYDROGEN ATOMS.

A. F. Gorshanova and R. Ya. Damburg. Optics and Spectroscopy (U.S.S.R.)(English Translation), 12: 55-6(Jan. 1962).

Results of calculations of the partial cross sections for elastic scattering and for excitation of the 2s and 2p levels of atomic hydrogen from the 1s ground state are given. The calculations were performed in a total angular momentum representation; exchange effects were neglected, and three states were taken into consideration: 1s, 2s, and 2p. Particular attention was given to coupling between these states. The data show that the schematic method reduces the cross sections for elastic scattering and for excitation of the 2s level, but increases the cross section for excitation of the 2p level. The quantitative results thus obtained are quite different from those obtained by numerical integration of the system of differential equations. Preliminary calculations for $L > 0$ indicate a larger role of strong coupling also in this case. (P.C.H.)

18229 INVESTIGATION OF THE PLASMA JET IN A PULSED DISCHARGE. L. I. Grechikhin, L. Ya. Min'ko, and V. E. Plyuta. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 60-1(Jan. 1962).

Properties of the plasma jet, which occurs when a discharge pulse emerges from an orifice in air at atmospheric pressure, were studied. The discharge, which was oscillatory, took place between a perforated flat electrode and a pointed electrode oriented along the axis of the hole. Investigation of luminescence in the stream revealed the following: The intensity of emission varies as a function of the distance of the stream from the flat electrode. The region with the brightest emission is located directly at the electrode edge; it is followed by a region of weak emission. Behind the region of weak luminosity, there is a region of high luminosity separated from the former by a sharp borderline, the intensity of which gradually decreases. It was also found that the intensity of the emission follows the current. After the discharge is extinguished, there is a fairly long afterglow ($\sim 10^{-4}$ sec). The plasma was also found to consist of separate streamers. A qualitative explanation of the stream structure is suggested. (P.C.H.)

18230 ABSOLUTE INTENSITIES OF THE INFRARED BANDS OF THE DEUTEROMETHANES (COMPARISON WITH EXPERIMENT). [PART] IX. Optics and Spectroscopy (U.S.S.R.)(English Translation), 12: 66(Jan. 1962).

The quantities Γ_e were determined and a comparison with experiment was made for 23 bands of methane and its deuterium substituted species for which experimental values of Γ_e or J_e were available. It was found that for most of the bands or groups of bands a fair agreement exists between theory and experiment, the relative error amounting to 1 to 15%. For 4 groups of bands the relative error reaches 29 to 40%. This is ascribed to two causes: inaccuracy of experimental data, and the effect of electrical anharmonicity. Calculation of the intensities for the deuteromethanes with different parameters shows that the discrepancy between theory and experiment is sharply increased. Data are tabulated. (P.C.H.)

18231 QUENCHING OF THE RADIOLUMINESCENCE OF TERPHENYL SOLUTIONS IN DIOXANE BY BROMIDES. V. I. Gusynin and V. L. Tal'roze. Optics and Spectroscopy (U.S.S.R.)(English Translation), 12: 71(Jan. 1962).

The quenching effect of a series of bromine compounds (propyl, amyl, nonyl, isopropyl, and allyl bromides) on the luminescence of terphenyl–dioxane solutions was studied. None of the materials, except allyl bromide, absorbed in luminescence of terphenyl. The optical absorption of a solution of allyl bromide in dioxane amounts to about 1%. Results show that the quenching is caused essentially by the transfer of energy from the solvent molecules and approaches the effectiveness of energy transfer from solvent to activator. The quenching cross sections were practically identical for all three of the normal bromides and also for isopropyl bromide. For the group of bromides studied, the effect of energy transfer along the chain is not manifested in the quenching of luminescence. (P.C.H.)

18232 THE ROLE OF EXCHANGE IN THE EXCITATION OF THE 2s AND 2p LEVELS OF HYDROGEN BY ELECTRONS. R. K. Peterkop. Optics and Spectroscopy (U.S.S.R.)(English Translation), 12: 77-8(Jan. 1962).

A calculation of the cross section for the excitation of a hydrogen atom by the distorted wave method, neglecting strong coupling, is reported. The problem was solved in terms of the total and projected orbital momenta. Three incident waves were considered: $L = 0$, 1, and 2. For $L = 1$ and 2, only the scattered wave with momentum $L = 1$ was considered in the 1s-2p transition. Cross section data for different values of impulse $[2mE/\hbar]$ and momentum in the incident electron, which are tabulated, show that exchange is important at low energies. Basically, allowing for exchange considerably improves the accuracy of the direct excitation term. The effect of exchange rapidly decreases with increasing energy. The fact that the sum of the three partial cross sections exceeds the total experimental cross section at low energies evidently indicates the importance of 2s-2p and other couplings. (P.C.H.)

18233 MAGNETOHYDRODYNAMICS AND ELECTROHYDRODYNAMICS. Otmar M. Stuetzer (General Mills, Inc., Minneapolis). Phys. Fluids, 5: 534-44(May 1962).

A close analogy between the dynamic behavior of a plasma in a magnetic field and that of a unipolarly charged fluid in an electric field is found and mathematically investigated. General equations and their broad consequences are discussed. Unidirectional flow, small disturbances, and stability are compared. (auth)

18234 VELOCITY AND TEMPERATURE PROFILES FOR LAMINAR MAGNETOHYDRODYNAMIC FLOW IN THE ENTRANCE REGION OF A PLANE CHANNEL. J. L. Shohet (Johns Hopkins Univ., Baltimore), J. F. Osterle, and F. J. Young. Phys. Fluids, 5: 545-9(May 1962).

The entry problem in plane laminar magnetohydrodynamic flow is solved numerically for pertinent parameters describing the flow. The channel configuration is a parallel-plate channel having the Hartmann profile for its fully developed velocity flow. The equations are placed in a finite difference form to enable the essential nonlinearities of the principal equations to be used in the solution of the problem. Velocity, temperature, and pressure curves are presented from results of computational work. (auth)

18235 STABILITY OF A REVOLVING FLUID WITH VARIABLE DENSITY IN THE PRESENCE OF A CIRCULAR MAGNETIC FIELD. Wei Lai (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Fluids, 5: 560-6(May 1962).

The stability of an electrically conductive and incompressible fluid between coaxial rotating cylinders in the presence of a radial density gradient, as well as a circular magnetic field, is studied. The effects of gravity and of the heat generated through viscous and magnetic dissipation is neglected. An eigenvalue problem is formulated for rotationally symmetrical disturbances. Detailed calculations are made for the case of small spacing between the two cylinders. Three dimensionless parameters, each containing momentum, thermal, or magnetic diffusivities, are defined. Parametric equations for surfaces of marginal sta-

bility are given, and planes cutting such surfaces are drawn for the discussions of the roles played by the diffusivities. Both the momentum diffusivity and the magnetic diffusivity are capable of simultaneous stabilization and destabilization. (auth)

18236 HYDROMAGNETIC TURBULENT FLOW BETWEEN PARALLEL PLATES. J. N. Kapur and R. K. Jain (Univ. of Delhi). Phys. Fluids, 5: 589-92(May 1962).

Turbulent flow of an incompressible, electrically-conducting fluid between two parallel plates in the presence of an external, uniform magnetic field parallel to the plates is discussed. Starting with the Reynolds equations for hydromagnetics, which are reduced to three equations in seven unknowns, conclusions about the mean pressure distribution and turbulent fluctuations are drawn. Unlike the case of laminar flow, the mean velocity distribution is affected by the magnetic field through turbulent fluctuations, and the mean magnetic field distribution does not remain uniform. (auth)

18237 ELECTROMAGNETIC ACCELERATION OF A SHOCK WAVE IN A CONSTANT-AREA DUCT. T. F. Morse (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 5: 596-603(May 1962).

When a rapid current discharge occurs in a gas between two electrodes, a current sheet forms that accelerates into the gas and produces a shock wave, much as a piston in conventional gas dynamics. Due to the high velocities which it reaches, the shock wave ionizes the gas, and a plasma is formed in the region between the current carrying contact front and the shock wave. Nonsteady electromagnetic acceleration of a one-dimensional shock wave was studied for the case of an arbitrary but constant specific-heat ratio of the plasma. Approximate closed-form solutions for the velocity of the contact surface and shock wave were obtained, illustrating both the weak dependence of the contact front velocity on γ, and the relation between the fluid mechanical and "snowplow" models of the shock acceleration. For the case under consideration, the contact surface and shock positions are initially parabolic, and hyperbolic functions of time. The pressure may be approximated by a linear function of the Lagrangian variable. (auth)

18238 STABILITY OF STEADY-STATE EQUILIBRIUM DETONATIONS. Jerome J. Erpenbeck (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 5: 604-14(May 1962).

The hydrodynamic stability of one-dimensional, steady, equilibrium detonation waves is investigated through solution of the initial-value problem for the detonation equations, linearized in perturbations from the steady-state solution. A criterion for stability, depending on the sign of the real parts of the zeros of a certain function of the steady flow, is formulated. Determination of stability for a specific case through this criterion would involve extensive but feasible numerical computations. The hydrodynamic stability of states of chemical equilibrium is proved, this is pertinent to equilibrium detonations from both physical and mathematical considerations. (auth)

18239 CHARACTERISTIC LOCUS IN MAGNETO-FLUID DYNAMICS. Yen-Mow Lynn (New York Univ., New York). Phys. Fluids, 5: 626-8(May 1962).

The explicit Lundquist equation for the characteristic locus in magnetohydrodynamics is obtained in polar coordinates; these are relevant for investigating the detailed wave-front structure as well as associated singularities. (L.N.N.)

18240 HYDROMAGNETIC SCALING LAWS FOR FLUID TEMPERATURE DISTRIBUTION. G. H. A. Cole (Clarke, Chapman and Co., Ltd., Gateshead, Eng.). Phys. Fluids, 5: 628-9(May 1962).

The dimensionless scaling parameters for fluid temperature distribution are derived. These complete the hydromagnetic equations for fluid motion. (L.N.N.)

18241 CURRENT DISTRIBUTION IN A MAGNETIC ANNULAR SHOCK TUBE. James C. Keck (Avco-Everett Research Lab., Everett, Mass.). Phys. Fluids, 5: 630-2(May 1962).

Studies of shock shape and current distribution in a magnetic annular shock tube were made to obtain information on dynamic interactions of gases and magnetic fields and on the exact mechanism by which a magnetic field accelerates a gas. Contour plots of current distribution are presented; patterns depend on polarity. Growth of a gas bubble on the outside wall behind the current sheet is suggested in positive operation. For negative operation, most of the drive current flows at the shock front. (L.N.N.)

18242 FLOW MODEL FOR LARGE RADIUS-RATIO MAGNETIC ANNULAR SHOCK-TUBE OPERATION. F. J. Fishman and H. Petschek (Avco-Everett Research Lab., Everett, Mass.). Phys. Fluids, 5: 632-3(May 1962).

A model explaining features of the behavior of magnetic annular shock tubes of large radius ratio (J. C. Keck, Phys. of Fluids, 5: 630(1962)) is reported. The shape of the current sheet when the center electrode is positive, the speed of this current sheet, and the difference between positive and negative operation are discussed. (L.N.N.)

18243 SELF-DIFFUSION COEFFICIENT IN SOLID ARGON. R. Fieschi (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan), G. F. Nardelli, and A. Repanai Chiarotti. Phys. Rev., 123: 141-7(July 1, 1961). (CNI-103)

Self-diffusion in argon crystals is discussed on the basis of the mobility of vacancies, and in the scheme of the absolute rate theory. Detailed calculations were made for the heat of activation Q and for the preexponential factor D_0 including quantum corrections. The change of potential energy was evaluated first by minimizing the lattice energy with respect to the displacement of the four atoms around the diffusion particle and next by calculating first-order elastic relaxation of the entire lattice. The change of vibrational properties was evaluated in the Einstein approximation. Including the contributions for the hole formation, the values $D_0 = 4.20 \times 10^{-4}$ cm^2 sec^{-1}, $Q = 13.85 \times 10^{-2}$ ev, were found at T = 80°K, the zero-point energy was found to contribute 5% to the heat of activation. (auth)

18244 INELASTIC SCATTERING OF ELECTRONS IN GERMANIUM. Joseph Callaway and Fred W. Cummings (Aeronutronic, Newport Beach, Calif.). Phys. Rev., 126: 5-9(Apr. 1, 1962).

In doped, compensated samples of germanium at low temperatures, a scattering center analogous to the hydrogen molecule ion may be formed in which an electron (or hole) is shared between two donors (or acceptors). Mobile carriers can lose energy through excitation of this molecule. This mechanism of energy loss is probably important in the explanation of the negative resistance observed in lightly doped, compensated germanium at liquid helium temperatures. A calculation of the average rate of energy loss is reported. (auth)

18245 VELOCITY SHIFT OF THE MÖSSBAUER RESONANCE. A. A. Maradudin, P. A. Flinn, and S. Ruby (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 126: 9-23(Apr. 1, 1962).

The mean square velocity of an impurity atom in a crys-

tal lattice is evaluated in both the low and high temperature limits. The result for the high temperature limit includes the effect of force constant differences between solute and solvent atoms as well as the effect of mass difference. The effect of a mass difference alone is quite small in both temperature regions. A determination of the Mössbauer peak position as a function of temperature in the high temperature range can be used to obtain a value of isomeric shift fully correct for the second order Doppler shift associated with the vibration of the atoms. In addition, if the experimental data are sufficiently precise, the effective stiffness with which the atoms are bound in the lattice may be determined. The calculation is carried out as an example using experimental data for Fe^{57} diasolved in beryllium and in stainless steel. (auth)

18246 MÖSSBAUER STUDY OF HYPERFINE FIELDS AND ISOMER SHIFTS IN Fe_4N AND $(Fe,Ni)_4N$. G. Shirane, W. J. Takei, and S. L. Ruby (Westinghouse Electric Corp., Pittsburgh). Phys. Rev., 126: 49-52(Apr. 1, 1962).

Mössbauer measurements of Fe^{57} are made on ferromagnetic Fe_4N, which has a face-centered cubic arrangement of iron atoms with nitrogen at the body-center position. The hyperfine fields are 345 kgauss for the corner Fe and 215 kgauss for the three face-center Fe, approximately proportional to their magnetic moments, $3\mu_B$ and $2\mu_B$. The isomer shifts, measured against a stainless steel source, are 0.30 mm/sec for the corner Fe and 0.45 mm/sec for the face-center Fe. These values are consistent with their proposed electronic configurations of $3d^74s$ and $3d^84s$, which are derived on the assumption that the nitrogen at the body-center position acts as an electron "donor" to the face-center Fe. The Mössbauer spectra of $(Fe_{3.6},Ni_{0.4})N$ and $(Fe_3Ni)N$ are consistent with their ordered structures in which Ni replaces the corner Fe preferentially. (auth)

18247 RANGE OF HEAVY IONS IN SOLIDS. D. Powers and W. Whaling (California Inst. of Tech., Pasadena). Phys. Rev., 126: 61-9(Apr. 1, 1962).

The ranges of N, Ne, Ar, Kr, and Xe ions in Be, B, C, and Al are measured to ±10% for incident ion energies 500 kev. A monoenergetic ion beam from an electrostatic accelerator strikes a thick target of the absorber, and the penetration depth is determined by a momentum analysis of monoenergetic protons elastically scattered from the target and the embedded atoms. An expression relating the penetration depth to the actual path length is derived. A linear range-energy behavior is found for Ar, Kr, and Xe ions. For N and Ne ions dE/dX increases with ion energy. The experimental ranges are 20% shorter than theoretical values based on energy loss by elastic nuclear collisions. By including electronic contributions to the stopping process, agreement with experiment is achieved. (auth)

18248 THEORY OF DEFECT FORMATION IN ALKALI HALIDES BY IONIZING RADIATION. Fred E. Williams (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 126: 70-2(Apr. 1, 1962).

Assuming the creation at low temperatures by ionizing radiation of two halogen atoms at adjacent halide ion sites, a tight-binding approximation is used to estimate the time constants for the electronic and atomic relaxation processes. It is concluded that an appreciable fraction of the atoms may move before the positive holes further separate. The atomic motion is most probably to form two negative halogen molecule ions rather than a neutral halogen molecule. Each haolgen molecule ion acquires momentum in the [110] direction from interaction with the asymmetric crystalline field; and by "billiard ball" collisions concurrent with tunnelling of the positive hole, separation of the halide vacancy and the molecule ion may be achieved. A related mechanism of defect formation, requiring only a single ionization, is considered. (auth)

18249 STRUCTURE SENSITIVITY OF F-CENTER GENERATION BY X RAYS AT LOW TEMPERATURES. Charles L. Bauer and Robert B. Gordon (Yale Univ., New Haven). Phys. Rev., 126: 73-8(Apr. 1, 1962).

Internal friction and elastic modulus experiments suggest that F centers are formed at dislocations in alkali halides during x irradiation even at liquid helium temperature, but that enhanced colorability is suppressed at low temperatures by the absence of diffusion of the generated centers. F-center growth curves are obtained for both as-received and plastically deformed (up to 15%) NaCl and KCl crystals at temperatures from 10 to 325°K. It is found that both the rate of capture of electrons by negative-ion vacancies and the final saturation concentration of F centers are strongly temperature sensitive, and that there exists an optimum temperature at which a given color center concentration is attained with a minimum amount of irradiation. The colorability of lightly deformed crystals is found to be enhanced only at temperatures where diffusion of F centers appears to be possible; otherwise a rapid saturation of the coloration is observed. However, the initial F-center growth rate in a heavily deformed crystal, relative to an undeformed one, becomes larger as the temperature is decreased, and can be interpreted in terms of the presence of a larger number of F centers formed near dislocations. With further x irradiation, this additional contribution saturates. (auth)

18250 VIBRATIONAL WAVE FUNCTIONS FOR ANHARMONIC CRYSTALS. Thomas H. Walnut (Syracuse Univ., N. Y.). Phys. Rev., 126: 83-92(Apr. 1, 1962).

An analysis is made of the way in which the behavior of various wave functions approximates that of exact vibrational eigenfunctions of an anharmonic crystal. The criterion used in determining the closeness of approximation is the order of magnitude of the difference between the second moment and the square of the first moment of the Hamiltonian operator. The functions chosen are products of harmonic oscillator wave functions, three different linear combinations of products of harmonic oscillator functions differing slightly in form from the exact eigenfunction, and a function that is the result of operating on an exact eigenfunction with a dipole moment operator. The first of these functions gives a value of the criterion that is proportional to the number of unit cells in the crystal. For the other functions the criterion is independent of the size of the crystal but is not zero. It is shown that, despite the fact that product functions are very poor approximations to eigenfunctions, quantities such as vibrational absorption intensities and frequencies calculated with product functions should give approximate agreement with experiment and that perturbation theory calculations using product functions can also give approximately correct results. It is also shown that results obtained using the product wave functions have intrinsic limitations on their accuracy that arise from the collective interaction of all the phonons or modes of vibration. (auth)

18251 SOLUTION OF SCHRÖDINGER EQUATION FOR A PERIODIC LATTICE. [PART] II. Leonard Eyges (Massachusetts Inst. of Tech., Lexington). Phys. Rev., 126: 93-102(Apr. 1, 1962).

The wave function and energy are expanded in powers of k. The equations determining the wave function to any given order in k are then inhomogeneous linear equations, which are practical to solve. Formulas for evaluating the energy

from these wave functions are given. For bands that are not degenerate at k = 0 these involve straightforward summations over the reciprocal lattice; for bands which are degenerate at k = 0, a derivation is shown for the secular determinant that gives the splitting of these bands. The elements of this determinant can also be calculated as sums over the reciprocal lattice. Tight-binding formulas in this formalism are discussed, and the evaluation of these formulas is given. Expressions involving the radial derivatives of the atomic momentum space wave functions are given for evaluating the energy in powers of k; these formulas do not make near-neighbor approximations. For cases for which neither the tight-binding approximation nor an expansion in powers of k is appropriate, the direct numerical solution of the equations is discussed and partial wave expansion is given. (auth)

18252 FLUX QUANTIZATION AND THE CURRENT-CARRYING STATE IN A SUPERCONDUCTING CYLINDER. H. J. Lipkin, M. Peshkin, and L. J. Tassie (Argonne National Lab., Ill.). Phys. Rev., 126: 116-17(Apr. 1, 1962).

London's phenomenological theory is modified to include quantization of angular momentum in the boson gas model of a superconductor. The modified London equation is solved in ring geometry to find the magnetic field in the penetration region. The unit of flux quantization is obtained for all thicknesses of the superconductor. The relation between angular momentum and kinetic energy in the current-carrying state is discussed. (auth)

18253 NUCLEAR MAGNETIC RELAXATION IN IONIC CRYSTALS AT HIGH TEMPERATURES. P. P. Mahendroo and A. W. Nolle (Univ. of Texas, Austin). Phys. Rev., 126: 125-9(Apr. 1, 1962).

The spin-lattice relaxation time is measured by the recovery method for Na^{23} and F^{19} nuclei in NaCl, NaF, BaF_2, and LiF, at temperatures up to approximately 900°K. The Na^{23} relaxation time is well predicted by phonon-phonon interaction theory at the lower temperatures, and by vacancy diffusion theory in higher ranges. The F^{19} relaxation time at the lower temperatures (below 500 to 700°K, depending on the compound) is attributed to spin-spin diffusion in conjunction with paramagnetic impurities; at higher temperatures a decrease consistent with the effects of vacancy diffusion is observed, with an activation energy of 0.65 ev in NaF and of 0.82 ev in BaF_2. (auth)

18254 NONADIABATIC THEORY OF ELECTRON-HYDROGEN SCATTERING. A. Temkin (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev., 126: 130-42(Apr. 1, 1962).

A rigorous theory of the s-wave elastic scattering of electrons by hydrogen is presented. The Schrödinger equation is reduced to an infinite set of coupled, two-dimensional, partial differential equations. A zeroth order scattering problem is defined by neglecting the coupling terms of the first equation. An exact relation is derived between the phase shift of this zeroth order problem and the true phase shift. The difference between these is contained in a rapidly convergent series whose terms correspond adiabatically to multipole distortions of the hydrogen by the incoming electron. The physical significance of the zeroth order problem is discussed. The exchange approximation for s-wave scattering is shown to be a variational approximation of the zeroth order problem. A perturbation theory is introduced to calculate the higher order corrections. The dipole correction has an increasingly important quantitative effect in the limit of zero energy. The effect of the long-range part of this correction on the scattering length can be expressed by a formula in terms of inverse powers of a long-range parameter R. Phase shifts for both singlet and triplet scattering are calculated, including up to quadrupole terms. The convergence is such that this number of terms should yield better than four-place accuracy. Uncertainties in calculated values decrease the accuracy to approximately three significant figures. (auth)

18255 1 ^1S, 2 ^1S, AND 2 ^3S STATES OF Li^+. C. L. Pekeris (Weizmann Inst., Rehovoth, Israel). Phys. Rev., 126: 143-5(Apr. 1, 1962).

The ionization energy J, excluding the Lamb shift, of the ground state of Li^+ is evaluated for determinants up to order n = 444. J(444) = 610087.449 cm^{-1}, and an extrapolated value $J(\infty)$ = 610087.445 cm^{-1}. For the 2 ^1S state a theoretical ionization energy of 118704.88 cm^{-1} is obtained, as compared with the experimental value of 120008.30 ± 0.10 cm^{-1}. It appears that the 8517.4-Å line is incorrectly identified as the 2 ^1S–2 ^1P transition. It should be looked for at 9584 Å. For the 2 ^3S state the ionization energy is found to be 134044.12 cm^{-1}, in agreement with the experimental value of 134044.19 ± 0.10 cm^{-1}. (auth)

18256 MAGNETIC SUSCEPTIBILITY OF THE HYDROGEN MOLECULE. J. P. Auffray (New York Univ., New York). Phys. Rev., 126: 146-7(Apr. 1, 1962).

The effects of the nuclear motion on the magnetic susceptibility $(\xi)_{0,1}$ of H_2 in the v = 0, J = 1 vibrational–rotational level of its electronic ground state are investigated. The dependence of $(\xi)_{0,1}$ on the orientation of the molecule in the applied magnetic field is also considered. The effects of the nuclear motion are found to be of the order of 2 to 4 parts in 10^2. (auth)

18257 ELASTIC SCATTERING OF LOW-ENERGY ELECTRONS BY ATOMIC HYDROGEN. Philip G. Burke (Univ. of California, Berkeley) and Harry M. Schey. Phys. Rev., 126: 147-62(Apr. 1, 1962). (UCRL-9860)

The differential and total cross sections for elastic scattering of electrons by atomic hydrogen are calculated below the threshold for excitation of the second target quantum level (10.2 ev). A close-coupling approximation is used in which the total wave function is expanded in hydrogen eigenstates, and only terms corresponding to the 1s, 2s, and 2p states are retained; the wave function is symmetrized or antisymmetrized explicitly. The coupled set of integro-differential equations resulting from the approximate wave function is integrated numerically subject to standard boundary conditions, to yield the phase shift in each total spin and total angular-momentum state. The solution involves an iteration procedure to treat the integral terms, and a specialized integration scheme, including an asymptotic expansion of the solution, to overcome certain numerical difficulties associated with low-incident-electron energy. A striking feature of the results is the appearance in many of the spin and angular-momentum states of pronounced, extremely narrow Breit-Wigner resonances at energies slightly below the second quantum excitation threshold. The resonance lying lowest in energy is analyzed in detail; it occurs in the singlet S state. It is found to have a full width at half maximum of 0.109 ev, and to be centered at 9.61 ev. The long-range polarization effect is found to be dominant only at and very near zero energy for S and P states; for D states it is important up to 6 or 7 ev, and for F states it is of central importance for almost the entire range of energy below threshold. (auth)

18258 POLARIZATION AND CORRELATION OF ELECTRON SPIN IN LOW-ENERGY ELASTIC ELECTRON-

HYDROGEN COLLISIONS. Philip G. Burke (Univ. of California, Berkeley) and Harry M. Schey. Phys. Rev., 126: 163-8(Apr. 1, 1962). (UCRL-6619)

The polarization and correlation of electron spin in low-energy electron-hydrogen scattering are investigated. The physical basis of such phenomena is discussed, and quantities in terms of which they may be measured are defined. Expressions relating these quantities before and after collision are given in terms of the singlet and triplet amplitude for electron-hydrogen scattering. These expressions are plotted as functions of scattering angle for incident electron energies below threshold for excitation of the second quantum level in hydrogen, using the results of an approximate close-coupling solution of the associated scattering problem. (auth)

18259 ATOMIC MANY-BODY PROBLEM. I. GENERAL THEORY OF CORRELATED WAVE FUNCTIONS. Levente Szász (Haverford Coll., Penna.). Phys. Rev., 126: 169-81(Apr. 1, 1962).

The general theory of atomic wave functions that explicitly depend on the distances between the electrons is presented. The total wave function for the atom will be written as a composition of one-electron spin-orbitals, and 2-electron, 3-electron, ... N-electron functions, respectively. The wave function has the following properties: it becomes identical with the exact solution of the many-body problem upon expansion of the many-electron functions in terms of a complete set of Slater determinants; it represents superposition of configurations if the many-electron functions are written in the form of linear combination of a finite set of determinants; and it represents a generalization of the Hylleraas r_{12}-method upon introduction of the interelectronic distances explicitly into the many-electron functions. It is shown that the many-electron functions can be orthogonalized with respect to the one-electron spin-orbitals, without restricting the generality of the total wave function. General formulas for the matrix components of the Hamiltonian with respect to correlated functions are derived. The approximation containing only 2-electron correlations is discussed, and it is shown that in this approximation all matrix components can be reduced to 2-electron and 3-electron integrals, respectively. The calculation of the 3-electron integrals is shown to be simplified by introducing two interelectronic distances as integration variables. (auth)

18260 PLURAL SCATTERING OF 20-kev ELECTRONS IN ALUMINUM. L. Marton, J. Arol Simpson, H. A. Fowler, and N. Swanson (National Bureau of Standards, Washington, D. C.). Phys. Rev., 126: 182-92(Apr. 1, 1962).

The angular and energy distribution of 20-kev electrons, scattered at very small angles ($<10^{-2}$ rad) by transmission through aluminum foils, are compared with the theory of plural inelastic scattering, under the following assumptions: the probability of elastic scattering at very small angles is negligibly small in comparison with the probability of inelastic scattering; inelastic scattering occurs predominantly through sharply defined "characteristic" energy losses, whose number follows a Poisson statistical distribution; the angular distribution in each loss follows a simple law; $\Phi(\theta) \propto (\theta_E^2 + \theta^2)^{-1}$; and the cumulative angular distribution from plural inelastic scattering is obtained by repeated "folding" of $\Phi(\theta)$ with the angular spread of the incident beam. The angular distribution of zero-loss electrons is found to be substantially independent of the foil thickness; the normalized angular distributions of the first- and second-loss peaks are accurately fitted by the "folding" calculation; Poisson statistics gives a good approximation to the observed numbers of energy losses. The value of λ for five observations on foils of thicknesses 650 to 2580 Å is approximately 810 Å, independent of thickness; systematic errors in the method of observation may render this value up to 20% higher than the mean free path corresponding to the total cross section. (auth)

18261 ANNIHILATION OF POSITRONS FROM THE H^-e^+ GROUND STATE. S. M. Neamtan, G. Darewych, and G. Oczkowski (Univ. of Manitoba, Winnipeg, Can.). Phys. Rev., 126: 193-6(Apr. 1, 1962).

The problem of the binding of a positron to negative hydrogen ion is treated by the variational method with a four-parameter trial function. The best values of the parameters yield a binding energy of 0.228 ev against the most favored mode of dissociation into hydrogen plus positronium. Pair annihilation from the ground state of similar bound H^-e^+ systems might be expected to contribute a principal component to the radiation from the annihilation of positrons in the alkali hydrides. The theory of positron annihilation is extended for application to this problem. The ground-state wave function yields a mean life against two-photon annihilation of about four times that for singlet positronium, the difference arising mainly out of spin considerations. The calculation of the angular correlation of the annihilation radiation indicates a narrower peak than those observed in LiH and NaH. (auth)

18262 OPTICAL POTENTIAL FOR CLOSELY COUPLED STATES. M. H. Mittleman (Univ. of California, Livermore and Berkeley) and Robert Pu. Phys. Rev., 126: 370-2(Apr. 1, 1962). (UCRL-6663-T)

The method of closely coupled states is shown to be the lowest order approximation to a suitably modified optical potential set of equations. These equations are then used with a variational expression for the scattering amplitude to give an estimate for the correction to the method of closely coupled states. (auth)

18263 FORMAL THEORY OF REARRANGEMENT COLLISIONS. [PART] II. M. H. Mittleman (Univ. of California, Livermore and Berkeley). Phys. Rev., 126: 373-5(Apr. 1, 1962). (UCRL-6674-T)

A formulation of the rearrangement collison problem is extended by utilizing an extension of the theory of the optical potential. (auth)

18264 SCATTERING OF THERMAL RARE GAS BEAMS BY ARGON. INFLUENCE OF THE LONG-RANGE DISPERSION FORCES. Erhard W. Rothe, Lawrence L. Marino, R. H. Neynaber, P. K. Rol, and S. M. Trujillo (General Dynamics/Convair, San Diego, Calif.). Phys. Rev., 126: 598-602(Apr. 15, 1962).

Total cross sections are measured for scattering atomic beams of He, Ne, Ar, Kr, and Xe by argon. A modulated beam technique is employed. The apparatus has an angular resolution of 1.5 minutes of arc. The data are correlated assuming an attractive interatomic potential $V(r) = -C/r^6$, in which case the cross section Q is given by $Q = b(C/v_r)^{2/5}$ where b is a constant and v_r is the relative velocity. Values of C may be estimated from theoretical expressions and from experimental data on transport properties in gases. By using these sources for C, the corresponding Q's may be calculated. The experimental cross sections are higher than those calculated. For the argon-argon interaction, for example, a theoretical expression for C indicates that $Q = 410 Å^2$. From viscosity data Q should be $383 Å^2$. The experimental value is $468 Å^2$. The discrepancy is beyond experimental error. (auth)

18265 THEORY OF THE HYDROGEN MASER. Daniel Kleppner, H. Mark Goldenberg, and Norman F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev., 126: 603-15(Apr. 15, 1962).

The behavior of the atomic hydrogen maser is analyzed for both stationary and transient operation. An expression for noise in the signal from the maser oscillator is derived. A variety of relaxation phenomena are analyzed, including effects of chemical reaction with the surface and magnetic field inhomogeneities. Several mechanisms leading to frequency shifts in the maser are also analyzed, including cavity pulling and the Doppler effect. (auth)

18266 ELECTRON NUCLEAR DOUBLE RESONANCE STUDY OF LITHIUM A CENTERS IN KCl. Robert Lee Mieher (Technische Hochschule, Stuttgart). Phys. Rev. Letters, 8: 362-5(May 1, 1962).

It was shown, using polarized light, that A centers can be polarized in a [100] direction and have a second optical absorption band under the F band. It was proposed that the A center is an F center associated with a Na ion in one of the six nearest neighbor positions. An optical study of a similar center, in which the F center is associated with a Li impurity, and an electron nuclear double resonance study that verifies the general A-center model of an F-center associated with an alkali impurity are reported. (L.N.N.)

18267 $1 \neq 0$ PAIRING IN SUPERCONDUCTORS. Daniel Hone (Univ. of Illinois, Urbana). Phys. Rev. Letters, 8: 370-2(May 1, 1962).

It is shown that one- and two-particle Green's functions for superconductors whose Cooper pairs are in states of non-zero relative angular momentum (L. P. Gorkov and V. M. Galitskii, Soviet Phys.-J.E.T.P. 13: 792(1961)) do not describe a wave function for the isotropic state. It is impossible, in general, to construct a complete hierarchy of Green's functions with the first two given by the Gorkov-Galitskii functions. (L.N.N.)

18268 ELECTRON-ION RECOMBINATION BY COLLISIONAL AND RADIATIVE PROCESSES. Stanley Byron, Robert C. Stabler, and Paul I. Bortz (Ford Motor Co., Newport Beach, Calif.). Phys. Rev. Letters, 8: 376-9 (May 1, 1962).

Physical principles dominating the electron-ion three-body recombination process and forming the basis of a general method for calculating the electron temperature and the net rate of three-body recombination are discussed. Calculations and data are presented in graphical and tabular forms. (L.N.N.)

18269 ON THE RELATION BETWEEN THE EIGENVALUES IN RELATIVISTIC AND NON-RELATIVISTIC QUANTUM MECHANICS. E. C. Titchmarsh (Oxford Univ.). Proc. Roy. Soc. (London), A266: 33-46(Feb. 27, 1962).

Rigorous analysis was applied to the problem of treating Dirac's relativistic equations in quantum mechanics as a perturbed form of Schrödinger's equation, with small perturbation parameter c^{-1}, where c is the velocity of light. It is proved that in certain cases the perturbed eigenvalues and eigenfunctions can be expanded in convergent series of inverse powers of c. The well-known case of the hydrogen atom is a simple example. (auth)

18270 A CLASS OF EXACT SOLUTIONS OF CERTAIN CLASSICAL FIELD EQUATIONS IN GENERAL RELATIVITY. A. Das (Dublin Inst. for Advanced Studies). Proc. Roy. Soc. (London), A267: 1-10(Apr. 24, 1962).

Model statical universes representing exact solutions of some field equations in general relativity are presented. Three of this type are discussed; they correspond to combinations of gravitation respectively with electromagnetic field, scalar or pseudo-scalar field, and Maxwell-Dirac field. Such statical solutions are possible in the first two cases only if mass density and charge density are equal in magnitude, and in the third case only if mass and charge are equal in magnitude, so that matter is in equilibrium under the action of gravitation and other forces. The field equations are classical in the sense that no second quantization is involved. (auth)

18271 THE COEFFICIENT OF VISCOSITY OF ATOMIC HYDROGEN FROM 25 TO 300°K. R. A. Buckingham (Univ. of London) and J. W. Fox. Proc. Roy. Soc. (London), A267: 102-18(Apr. 24, 1962).

The elastic scattering of two H atoms in the singlet ground state was investigated on the basis of a deep square-well potential, bounded by the long-range van der Waals attraction. Phase shifts with their appropriate multiples of π are presented for L = 0(1)29. Some phase shifts exhibit a step-like gain of π with increasing wave number. This phenomenon is illustrated by wave function graphs and is discussed. Viscosity cross sections are given. For scattering in the triplet ground state, a Buckingham-Corner form of potential was used and previously calculated cross sections were extrapolated and applied. Effective rigid-sphere diameters were estimated by the empirical method of Hirschfelder & Eliason, both for the approximate and accurate potentials. Two curves are given for the temperature dependence of the coefficient of viscosity, one calculated, the other estimated, and the true curve should lie nearer the latter. (auth)

18272 QUANTUM FIELD THEORY WITH INDEFINITE METRIC. Yasuo Munakata (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 361-72(Feb. 1962). (In English)

Yokoyama's model, a convergent model in quantum field theory with indefinite metric, is investigated in a simplified version. Five spinor fields in the model, one physical and the remainder unphysical, are replaced by the corresponding neutral scalar fields, and a physical neutral scalar field is replaced by a prescribed external field. Apart from the interaction with the external field, the equation of motion can be solved in the Heisenberg representation using two sets of "dipole ghost" fields. The paraticle picture of the physical field is established. The unitarity condition of the physical S-matrix is violated in the second order perturbation in the external field. Possible sources of this discrepancy are discussed, and future prospects of the theory with indefinite metric of this type are considered. (auth)

18273 ON A CONVERGENT MODEL OF QUANTUM FIELD THEORY WITH INDEFINITE METRIC. [PART] II. Kan-ichi Yokoyama (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 373-95(Feb. 1962). (In English)

The unified general form of the Lagrangian of a convergent model of quantum field theory with indefinite metric, including two cases previously proposed, is investigated. Starting from this Lagrangian, the unitarity of the actual S-matrix is shown by a different approach. The graphical contents concerning the physical processes described by the actual S-matrix are not altered. Every point vertex in the usun' theory is exactly replaced by an extended vertex, the structure providing sufficient convergency for the results. It is shown that the bi-linear interaction terms connecting the physical spinor field with the unphysical spinor fields are never eliminated. The mass renormalization is investigated to exclude singularities of the propagator of the physical spinor field, except the one corresponding to a

physical mass. The problem of mass levels of the physical spinor field is dissolved. (auth)

18274 THE RESPONSE OF ORGANIC SCINTILLATORS TO ELECTRON ENERGY DEPOSITED IN THEM. Eric Brannen and Garth L. Olde (Univ. of Western Ontario, London, Ont.). Radiation Research, 16: 1-6(Jan. 1962).

The response of organic scintillators to electron energy deposited in the medium was investigated during work concerned with the validity of results obtained with a scintillation dosimeter. The fluorescent yield of such scintillators was shown to be proportional to energy deposition in the medium down to energies of 20 kev by using an iron-free β-ray spectrometer and a well-type scintillator. Nonlinear effects can be expected to occur only near the surface of the scintillator. (auth)

18275 ACOUSTIC TECHNIQUES IN MAGNETIC RESONANCE. D. I. Bolef (Westinghouse Research Labs., Pittsburgh). Science, 136: 359-69(May 4, 1962).

After a brief introduction to the principles of nuclear magnetic resonance, the theory and practice of acoustic spin-phonon coupling of both nuclear and electron spins in solids are described. Acoustic coupling to nuclear and electron spins is a measure of relaxation in paramagnetic systems. Acoustic techniques are applied to quadrupolar coupling in the heavy alkali halides. The results show particular promise in the extension of acoustic NMR techniques to bulk metals and ferromagnetic crystals, and to the study of spin-lattice relaxation as a function of temperature. (N.W.R.)

18276 INFLUENCE OF SPIN DIFFUSION ON THE DYNAMIC POLARIZATION OF NUCLEAR SPINS. A. V. Kessenikh (Karpov Scientific Research Inst. of Physics and Chemistry, Moscow). Soviet Phys.-Solid State, 3: 2368-9(May 1962).

Taking into account the spin-lattice relaxation of nuclei, the diffusion equation for spin polarization is solved for dynamic polarization of nuclei that interact directly with paramagnetic centers whenever the electron paramagnetic resonance (EPR) of the center exhibits saturation. Neglecting the angular dependence of the diffusion coefficient, the average polarization in a specimen was $P \sim (T_1/T_2)$ (n/N) (for $n/N \ll 1$). The existence of an optimum concentration of paramagnetic centers n/N is discussed (n is the number of centers, and N, the nuclei per unit volume). (auth)

18277 IONIZATION OF GASES BY FAST HYDROGEN ATOMS AND PROTONS. E. S. Solov'ev, R. N. Il'in, V. A. Oparin, and N. V. Fedorenko (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 659-68 (Mar. 1962). (In Russian)

Ionization of the gases H_2, N_2, Ne, Ar, and Kr by 10- to 180-kev hydrogen atoms and protons is investigated. The ionization cross section, stripping cross section for fast hydrogen atoms, and cross section for production of slow ions with various e/m ratios are measured. The cross sections for stripping of hydrogen atoms and for ionization of atoms and molecules by protons are compared with available theoretical data obtained in the Born approximation. Factors influencing the relation between various ionization cross sections and the position of the peaks in the energy dependence of the cross sections are discussed. (auth)

18278 CHARGE EXCHANGE OF Xe^{3+} AND Xe^{4+} IN NEON. G. N. Ogurtsov and I. P. Flaks (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 721-4(Mar. 1962). (In Russian)

The cross sections for electron capture in single collisions between Xe^{3+} and Xe^{4+} ions and Ne atoms are measured. For accelerating voltages between 2 to 30 kv the capture cross sections σ^{32} and σ^{43} are large and attain values of the order of 10^{-15} cm^2. The absolute magnitude of σ^{32} is greater than that of σ^{43} and is maximum at a relative ion velocity $V \approx 10^7$ cm/sec. The cross section σ^{43} grows with the kinetic energy of the Xe^{4+} ions for all velocities in the investigated interval. The experimental data are compared with results of calculations carried out by the Landau–Zener method of pseudo-intersection of potential energy curves. The agreement between the calculated and experimental curves for $\sigma^{32}(v)$ and $\sigma^{43}(v)$ is satisfactory. (auth)

18279 ON THE ASYMPTOTIC LAW OF SMOOTHING OUT OF THE DISCONTINUITY IN A MONOATOMIC GAS. R. G. Barantsev (Leningrad State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 889-95(Mar. 1962). (In Russian)

The structure of a shock wave in a monoatomic gas is studied with the help of the integral kinetic equations derived by Wallander. Asymptotic laws for smoothing out of the density, velocity, and temperature profiles can be determined in a first approximation to the gas-dynamic solution. The form of the asymptotic formulas appreciably depends on the behavior of the collision cross section for large values of the relative velocity of the colliding particles. (auth)

18280 APPARATUS FOR IONISING A GAS TO OBTAIN HIGH INTENSITY PULSED IONS OR ELECTRONS. Siegfried Klein (to Commissariat à l'Énergie Atomique). U. S. Patent 3,015,745. Jan. 2, 1962.

A source of high-intensity pulsed ions or electrons is designed with supplies a pulsed current of several tens of amperes. The source comprises an induction coil and a condenser connected in parallel and fed with a steady high voltage; pulses are applied to a gas in an insulating tube in the field of the coil, and the ionized gas short-circuits the terminals of the applied voltage, so that a large current flows through the gas. (D.L.C.)

18281 METHOD AND APPARATUS FOR GENERATING NEUTRONS. Leonard Reiffel (to Armour Research Foundation). U. S. Patent 3,016,461. Jan. 9, 1962.

An apparatus for producing monoenergetic neutrons is designed which gives high efficiency without the need for very low pressures. The apparatus comprises a closed envelope containing deuterium and/or tritium gas at 10 to 1000 μ Hg, an ionizing electrode, and a pair of spaced accelerating electrodes. A low potential is established between the ionizing electrode and one of the accelerating electrodes, and a higher potential is established between the accelerating electrodes. An electric discharge is created between the ionizing electrode and one accelerating electrode, and the ions are accelerated into another portion of the envelope to react with un-ionized gas to produce neutrons. (D.L.C.)

18282 METHOD OF STABILIZING THE OUTPUT OF A NUCLEAR EMISSION SOURCE. Arthur H. Youmans and Thomas P. Hubbard, Jr. (Well Surveys, Inc.). U. S. Patent 3,019,340. Jan. 30, 1962.

A method is given for stabilizing the output of devices which produce nuclear emission by ion bombardment, particularly a neutron source comprising a sealed ion accelerator and an acceleration voltage generator such as is used in well logging. In the method, stabilization is achieved by selecting the target thickness and ion accelerating voltage so that, due to the resonance peak of

the reaction, operation at a maximum point on the emission yield curve is obtained. (D.L.C.)

18283 RADIANT ENERGY CONTROL. Harold Berger and Franklyn E. Fairman (General Electric Co.). U. S. Patent 3,025,402. Mar. 13, 1962.

A mobile radiation apparatus is designed which may be adjusted to give a radiation beam of a desired configuration and diverging angularity. The apparatus comprises a housing for enclosing a radiation source, and the source is in the form of a disc of radioactive metal secured in a seat at the edge or rim of a cylindrical member rotatably mounted in a pocket in the housing. The cylindrical member may be rotated to move the source between a shielded position and a port for emitting a conical ray beam. Biasing means urge the source toward the shielded position, thus providing a "fail-safe" feature. (D.L.C.)

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Refer also to abstracts 18114, 18115, and 18118.

18284 (AFSWC-TDR-62-26) INVESTIGATION OF H^4 AND Li^4 FOR ASTROPHYSICAL APPLICATIONS. Final Report, January 1961 to March 1962. W. L. Imhof, F. J. Vaughn, L. F. Chase, Jr., H. A. Grench, R. G. Johnson, and M. Walt (Lockheed Missiles and Space Co., Palo Alto, Calif.). Mar. 1962. Contract AF29(601)-1765. 47p.

A search for H^4 and Li^4 was made by looking for radioactivities produced in the following reactions: He^3 (P,γ) Li^4, He^3 (d,n) Li^4, H^3 (d,p) H^4, H^3 (n,γ) H^4, and Li^7 (n,α) H^4. The possible existence of Li^4 was also studied by direct observation of the gamma rays produced in the He^3 (p,γ) Li^4 reaction. In none of the measurements was any evidence seen for the existence of Li^4 or H^4. From the activation runs, upper limits to the cross sections were obtained as a function of lifetime, for half-lives extending from as short as 10^{-6} seconds to as long as 10^{+5} seconds. The various reactions were investigated over different portions of the half-life range. The results obtained provide evidence that neither Li^4 nor H^4 is particle-stable. (auth)

18285 ACCRETION OF SOLAR WIND TO FORM A LUNAR ATMOSPHERE. M. P. Nakada and J. D. Mihalov (California Inst. of Tech., Pasadena). J. Geophys. Research, 67: 1670-1(Apr. 1962).

Although the solar wind may provide the principle removal mechanism for heavier residual lunar gases, it may be a strong source for whatever atmosphere exists. Equilibrium densities for N, O, Ne, and Ar are presented in tabular form. (L.N.N.)

18286 ON THE TIME-DEPENDENT PRINCIPLE OF INVARIANCE IN A SEMI-INFINITE MEDIUM. Sueo Ueno (Kyoto Univ.). J. Math. Anal. and Appls., 4: 1-8(Feb. 1962).

For a semi-infinite medium in which the particle mean free time is much greater than the mean survival time of a photon (e.g., envelopes of novae, planetary nebulae, and cosmic clouds), a radiative transfer theory is derived that takes into account the irreversible leakage of radiation from the system. The time-dependent diffusion problem posed by this theory is solved by means of a transient scattering function. The explicit form of the integral equation for this scattering function is obtained. (T.F.H.)

18287 DATING THE GALAXY BY URANIUM DECAY. R. H. Dicke (Princeton Univ., N. J.). Nature, 194: 329-30 (Apr. 28, 1962). (PUC-1962-64)

Assuming that the heavy elements were produced early in the history of halo-population clusters, and that the U^{235}/U^{238} production ratio was between 1 and 2, the age of the galaxy is induced to be $(7.4 \pm 0.5) \times 10^9$ yr. Various alternative time dependences of the U production rate are considered. (T.F.H.)

18288 SOME METHODS FOR COMPUTING MODEL STELLAR ATMOSPHERES. Anne B. Underhill (Dominion Astrophysical Observatory, Victoria, B. C.). Quart. J. Roy. Astron. Soc., 3: 7-24(May 1962).

Arguments leading to equations for stellar atmospheres are presented. The method of solution developed for a moderate-speed, magnetic-drum computer and methods depending on fast computers having large, rapid-access memories are summarized. Solution of radiative-transfer equations is reduced to evaluation of a series expansion for the source function. Choosing the best expansion considering the characteristics of the problem is discussed. (L.N.N.)

Cosmic Radiation

18289 (AFCRL-62-287) ČERENKOV RADIATION ASSOCIATED WITH EXTENSIVE AIR SHOWERS. Technical Note No. 4. Henry Kasha, Yona Oren, and Kurt Sitte (Israel Inst. of Tech., Haifa). Sept. 1, 1961. Contract AF61(052)-196. 10p.

The Cherenkov light flashes accompanying the passage of extensive air showers through the atmosphere were studied at 200 m above sea level by means of telescopes with 4.9° half-opening angle, used in conjunction with an eight-tray hodoscope. Preliminary results showed that the spectrum of events accompanied by a light signal is flatter than that of all showers in the range of $\sim 10^5$ to 5×10^6 particles. The light intensity per shower electron was found to decrease with increasing shower size, while the fluctuations in this quantity increased with the size. The lateral light distribution between 5 and 80 m, rather flat ($\sim r^{-0.7}$) for showers of $< 2 \times 10^5$ particles, increased steeply with increasing shower size. It was possible to obtain information on the angular distribution of the Cherenkov light in extensive air showers with respect to the shower axis as viewed from a given distance from the center of the shower. It was found that the light intensity falls off by half at 10°. (auth)

18290 (AFCRL-1015) ENERGY DISSIPATION OF SPIRALING PARTICLES IN THE POLAR ATMOSPHERE. K. Maeda and S. F. Singer (Maryland. Univ., College Park). June 1961. Contract AF19(604)-3816. 21p. (AD-265005)

The magnetic field in the polar regions may be regarded as uniform and vertical to the earth's surface. Charged particles impinging into the atmosphere in these regions follow a spiral orbit along the magnetic line of force. Since the rates of energy loss of these particles are the same in all directions, the pitch angle, alpha, of these incident particles is constant till the end of the range of the particles. In other words, incident particles maintain spiral motions with constant pitch angles, while the radius of gyration decreases corresponding to the energy loss experienced by the particle with increasing atmospheric depth. (auth)

18291 (AFOSR-1545) I. TIME VARIATIONS IN COSMIC RAYS. II. CHARACTERISTICS OF EXTENSIVE AIR SHOWERS. Final Progress Report. Ismael Escobar V. (Universidad Mayor de "San Andrés," La Paz, Bolivia. Laboratoria de Física Cósmica de Chacaltaya). 1960. Contract AF49(638)-290. 67p.

Cosmic-ray variations prior to the onset of the Forbush

event, during the main phase of the decrease, and while the intensity was recovering were studied. The different methods and equipment in operation at Chacaltaya for studying the cosmic-ray intensity are described. Unusual phenomena in association with Forbush decreases is discussed. Studies of some exceptional cases of Forbush decreases which showed a difference in onset times are presented. Eleven detectors used to study extensive air showers and their operation at El Alto are described. The density spectrum of showers detected at El Alto and experimental results concerning the lateral distribution, size, spectrum, and the celestial arrival directions of showers are given. (M.C.G.)

18292 (GCA-TR-60-4-G) (A) CHARGED PARTICLES IN THE UPPER ATMOSPHERE. (B) RECOMBINATION COEFFICIENTS. Alexander Dalgarno (Geophysics Corp. of America, Bedford, Mass.). Jan. 1961. Revised June 1961. 115p. (AD-266519)

Information is included on elastic collisions of slow electrons with atmospheric particles, energy losses of slow electrons, elastic collisions of positive ions with atmospheric particles, thermal processes involving electrons, thermal ionic processes, electron capture, electron impact, collisional heating, and recombination coefficients. (J.R.D.)

18293 MEASUREMENTS OF THE INTENSITY AND SPECTRUM OF ELECTRONS AT 1000-KILOMETER ALTITUDE AND HIGH LATITUDES. B. J. O'Brien, C. D. Laughlin, J. A. Van Allen, and L. A. Frank (State Univ. of Iowa, Iowa City). J. Geophys. Research, 67: 1209-25 (Apr. 1962).

The intensity and spectrum of electrons at 1000-km altitude were measured by detectors on the SUI satellite Injun I at magnetic latitudes between about 45 and 80°. A preliminary report is given for July and August 1961. Trapped electrons above 40 kev were found between 45 and about 75° 10^5 to 10^6 particles $(cm^2\ sec\ ster)^{-1}$, with peak intensity at 4×10^6 particles $(cm^2\ sec\ ster)^{-1}$. The intensity above 75° was less than 10^2 particles $(cm^2\ sec\ ster)^{-1}$. Occasionally the electron intensity reached a broad peak around 50° and a second peak near the auroral zone. The intensity in the second region often varied by an order of magnitude in times of a few seconds or distances of a few tens of kilometers. If the differential electron spectrum followed a power law of the usual form $dN = \text{constant}\ E^{-\gamma}\,dE$, then, for both trapped and dumped electrons 40 to 120 kev, γ varied significantly between 0 and 2 below 60°, and between 0 and 7 at latitudes above 60°. The spectrum was generally softer at higher latitudes. In the daytime, electrons above 1 kev were observed in fluxes of the order of 10 ergs $(cm^2\ sec\ ster)^{-1}$ at such angles to the magnetic field vector that they must have penetrated to auroral altitudes of 200 ± 200 km. Since they could produce weak auroras, it is concluded that auroras can occur in the daytime. Since they were detected at 1000-km altitude, it is concluded that an acceleration mechanism in the ionosphere is not always necessary to produce an aurora in the same hemisphere. The measurements are compared with other satellite, rocket, and balloon measurements. Most of the counts of the type 302 shielded Geiger tube in Explorer VII were due to penetrating particles, likely electrons at several Mev in peak intensity of order 10^3 particles $(cm^2\ sec)^{-1}$. The significance of the latitude distribution of the low-energy electron fluxes is discussed. (auth)

18294 DIRECT OBSERVATIONS OF DUMPING OF ELECTRONS AT 1000-KILOMETER ALTITUDE AND HIGH LATITUDES. B. J. O'Brien (State Univ. of Iowa, Iowa City). J. Geophys. Research, 67: 1227-33(Apr. 1962).

Quiescent dumping of electrons above 40 kev of the order of 10^4 particles $(cm^2\ sec\ ster)^{-1}$ was detected by the Injun I satellite at about 1000 km and high latitudes around July 1, 1961. In 16 passes between 230 and 340°E, the angular distribution of electrons about the magnetic vector B showed there was dumping in every one of 8 passes between 1200 and 1500 local time, and in only one of 8 passes between 1900 and 2300. When there was no dumping, the directional intensity of electrons at ~20° from the normal to B was less than 1% of that normal to B. When there was dumping, the corresponding value was about 100%, and the intensity at about 50° from the normal to B was about 10% of that normal to B. Appreciable intensities of electrons were backscattered. Dumping was seen over very wide ranges of latitude between $L \sim 2$ and $L \sim 10$ and was uncorrelated with K_p. The dumped electrons may be either new, freshly injected, or accelerated particles, or they may be old, formerly trapped particles, which were perturbed in their orbits. The observations indicate that acceleration mechanisms must occur frequently above 1000 km. (auth)

18295 TIME VARIATIONS OF INTENSITY IN THE EARTH'S INNER RADIATION ZONE, OCTOBER 1959 THROUGH DECEMBER 1960. Guido Pizzella, C. E. McIlwain, and J. A. Van Allen (State Univ. of Iowa, Iowa City). J. Geophys. Research, 67: 1235-53(Apr. 1962).

A time variation of almost a factor of 3 was observed in the lower part of the earth's inner radiation belt using the Anton 302 Geiger tube in Explorer VII (satellite 1959) during Oct. 13, 1959, through Dec. 31, 1960. The time variation appears to occur in discrete steps temporally correlated with major solar proton events and/or major geomagnetic storms. In one instance, a significant change in inner-zone intensities occurred within less than 2 weeks. A strong impulsive source of the trapped particles throughout the inner zone exists and is of more quantitative importance than the neutron albedo decay products of the galactic cosmic radiation. (auth)

18296 ENERGY SPECTRUM OF GEOMAGNETICALLY TRAPPED PROTONS. Harry H. Heckman (Univ. of California, Berkeley) and Alice H. Armstrong. J. Geophys. Research, 67: 1255-62(Apr. 1962). (UCRL-9965)

The energy spectrum of protons in the inner Van Allen radiation belt was measured above 12 Mev using nuclear-track emulsions irradiated during the flight of a missile on Oct. 13, 1960. Above 100 Mev, the data agree with the albedo-neutron hypothesis. The spectrum falls below the calculations of Freden and White at high energies. The theory of Lenchek and Singer gives an improved fit to the data when the cutoff energy parameter has a value of 650 Mev. The anomalous behavior below 80 Mev, observed on July 21, 1959, is confirmed. The spectrum departs significantly from the calculations below 80 Mev. A maximum is reached at about 35 Mev, with a minimum indicated near 20 Mev. There is no evidence for a time variation of the spectrum above 80 Mev. Mass measurements were carried out on 783 tracks with residual ranges greater than 5 mm. Five deuterons were found. (auth)

18297 GEOMAGNETICALLY TRAPPED PROTONS FROM COSMIC-RAY ALBEDO NEUTRONS. A. M. Lenchek and S. F. Singer (Univ. of Maryland, College Park). J. Geophys. Research, 67: 1263-87(Apr. 1962).

Albedo neutrons from galactic cosmic rays account for the gross features of the observed geomagnetically trapped protons. This source leads to an equilibrium intensity (up

to several thousand km and at low latitudes) that compares favorably with observations, in the shape of the energy spectrum, in the spatial distribution, and in the absolute intensity. The anisotropic emergence of neutrons (above 50 Mev) and of nuclear interactions in the oxygen exosphere (above 300 Mev) is considered. The anisotropy of the albedo in effect steepens the neutron energy spectrum. More detailed features, such as the angular distribution, may also be computed from the neutron albedo theory, but no observations are available for comparison at present. The phenomenon responsible for the absence of trapped protons beyond about 2 earth radii is not understood. Nonadiabatic mechanisms are compared. Injection resulting from the neutron albedo from solar high-energy particles and the consequent transfer of charged albedo particles from polar latitudes to middle latitudes are examined. (auth)

18298 THE $He^3/(He^3 + He^4)$ RATIO IN PRIMARY COSMIC RADIATION. M. V. K. Appa Rao (Univ. of Rochester, N. Y.). J. Geophys. Research, 67: 1289-93(Apr. 1962). (NYO-10029)

The ratio $R = He^3/(He^3 + He^4)$ is determined using a nuclear emulsion stack exposed at geomagnetic 61°N on Aug. 3, 1958, under 3.8 g/cm^2 of matter. The ratio R found at the top of the atmosphere is 0.31 ± 0.08 for the same energy per nucleon (160 to 355 Mev) and 0.33 ± 0.08 for the same rigidity (1.05 to 1.48 Bev). These values are lower than previous observations, but in agreement within the statistical errors, thus implying little or no time variation in the ratio R for one year. (auth)

18299 RELATIONSHIP BETWEEN PRIMARY COSMIC RAYS AND THEIR SECONDARY COMPONENTS. R. P. Kane (Physical Research Lab., Ahmedabad, India). J. Geophys. Research, 67: 1295-1308(Apr. 1962).

Calculation of Dorman's coupling constants, which play a vital role in connecting changes of cosmic-ray secondaries with those of primaries, requires a precise knowledge of geomagnetic cutoff energies. Quenby and Webber considered quadrupole and higher-order terms of the geomagnetic field and obtained coupling constants significantly different from those of Dorman, especially for sea-level meson intensity. These are based on an experimental latitude effect to 15 Bev only, which is the cutoff energy for vertical cosmic rays at the equator. Extrapolations were performed for higher energies. For inclined directions, the cutoff energies range to about 30 Bev. These involve larger atmospheric paths and are not directly comparable to vertical intensities. Coupling constants for inclined directions are likely to give direct experimental clues to the shape of the coupling constant versus energy curves at 10 to 30 Bev. All available experimental azimuth effect data are examined. The analysis indicates that a simple dipole model of the geomagnetic field is inadequate; possible deviations are estimated. The revised coupling constants, though showing more similarity to Quenby and Webber's curves, also show odd features indicating that azimuth effect data are not sufficiently accurate. (auth)

18300 COSMIC RAYS AT BALLOON ALTITUDES AND THE SOLAR CYCLE. H. V. Neher and Hugh R. Anderson (California Inst. of Tech., Pasadena). J. Geophys. Research, 67: 1309-15(Apr. 1962).

Measurements of cosmic-ray intensity are made for most of the past solar cycle at balloon altitudes near the north geomagnetic pole. Such experiments were conducted during the summer months, but these data represent a relatively true measure of cosmic rays in the vicinity of the earth for that particular phase of the solar cycle, since large solar-flare activity was absent when these flights were made. The energy density of cosmic rays in the vicinity of the earth was 40% less in 1958 to 1959 than in 1954; new particles present in 1954 that were not present in 1951 were almost entirely those absorbed in 200 g cm^{-2} of the atmosphere; after the cosmic-ray maximum of 1954, the first particles to disappear were very absorbable, having an absorption length of about 60 g cm^{-2}; as the solar cycle progressed, the particles removed became increasingly energetic, until those that disappeared between 1957 and 1958 were absorbed about like primaries of mean rigidity 9 Bev; the particles reappearing after the cosmic-ray minimum of 1958 to 1959 have close to the same rigidity as those removed before the cosmic-ray minimum was reached, when the intensity was approximately the same; if the general solar activity can be measured by the Zurich sunspot numbers, a 9- to 12-month lag of cosmic-ray change from being anticorrelated with solar activity appears; and sunspot numbers averaged over periods comparable to 3 months appear to be a better measure of solar activity as it relates to cosmic-ray intensity than do similarly-averaged planetary magnetic-character figures. (auth)

18301 A STUDY OF SOLAR ACTIVITY ASSOCIATED WITH POLAR-CAP ABSORPTION. Constance S. Warwick and Marion Wood Haurwitz (National Bureau of Standards, Boulder, Colo.). J. Geophys. Research, 67: 1317-32(Apr. 1962).

Systematic examination of all unusual solar radio and optical emission before the onset of 43 polar-cap absorption (PCA) events shows which type of solar activity most frequently precedes PCA. This provides an objective basis for assignment of the solar event most probably associated with each PCA event. Relations among characteristics of solar and PCA events are examined. These data present little evidence for association of PCA with solar flares that occur on the far side of the sun, nor do they indicate any significant dependence of occurrence or of delay time of PCA on position of the associated flare. Delay from flare to absorption varies from values of minutes, appropriate to the energy of the solar particles, up to hours. A relation is found between delay time and phase of the solar cycle, with long delay times near the time of maximum solar activity. (auth)

18302 PROPAGATION OF SOLAR PARTICLES AND THE INTERPLANETARY MAGNETIC FIELD. Constance S. Warwick (National Bureau of Standards, Boulder, Colo.). J. Geophys. Research, 67: 1333-46(Apr. 1962).

Effects on the propagation of energetic solar particles indicate the presence of an interplanetary magnetic field. The effect of this field is greatest for particles of energy of about 10^9 ev, indicating that particles of lower energy, associated with polar-cap absorption, propagate as a group, with kinetic energy density comparable to the magnetic energy density of regions of the interplanetary field. A model proposed to explain characteristics of the solar particles accounts for the main features of solar modulation of galactic cosmic rays. (auth)

18303 AN AURORAL-ZONE ELECTRON PRECIPITATION EVENT AND ITS RELATIONSHIP TO A MAGNETIC BAY. R. R. Brown (Univ. of California, Berkeley) and W. H. Campbell. J. Geophys. Research, 67: 1357-66(Apr. 1962).

The relationship of an auroral-zone electron precipitation event to a magnetic bay was examined using simultaneous observations of x-ray intensity at balloon altitudes, ionospheric absorption of cosmic radio noise, geomagnetic

micropulsations in the 5- to 30-sec period range, and variations in the geomagnetic elements H, D, and Z. These observations show that an intense electron bombardment of the upper atmosphere was in progress prior to the bay and suggest that the current system of the bay was "triggered" by the sudden intensification and expansion of the electron precipitation. The motion of the current system of the westward electrojet and the electrons precipitating on the atmosphere was toward the north, indicating that processes well out of the lines of force through the auroral zone, rather than local field conditions, were responsible for the movement. (auth)

18304 ROCKET MEASUREMENT OF THE ELECTRON-DENSITY DISTRIBUTION IN THE TOPSIDE IONOSPHERE. S. J. Bauer and J. E. Jackson (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Research, 67: 1675-7(Apr. 1962).

A rocket was instrumented for measuring ionospheric electron densities using the two-frequency dispersive Doppler technique. Data were obtained only at 73.6 Mc, since the ground station provided measurement of the rate of change of phase difference between ordinary and extraordinary modes. Electron densities were obtained from Faraday rotation measurements, and theoretical profiles corresponding to a binary ion mixture ($O^+ + He^+$ and $O^+ + H^+$) at 1350°K were calculated. The 1% concentration level is shown, and geometric and geopotential altitudes are indicated. Data are presented in graphical form. (L.N.N.)

18305 ON THE HIGH-ENERGY ELECTRON-PHOTON COMPONENT IN EXTENSIVE AIR SHOWERS. Yoshio Toyoda (Kobe Univ., Japan). J. Phys. Soc. Japan, 17: 415-26(Mar. 1962). (In English)

Using a large multiplate cloud chamber containing absorbers of 43 radiation lengths and 24 density detectors, characteristics of the electron-photon component of energy above 1 Bev in extensive air showers (EAS) were studied at sea level. The size N of the selected shower extended from 2×10^4 to 5×10^6. Results were compared with data observed at 2770 m altitude. The mean lateral distribution of the high-energy electron-photon component at 1 to 20 Bev can be represented by the form $(r + 2)^{-n}$, with n expressed by $2.6\ E^{0.24}$, where the energy E and the distance from the axis r are measured in Bev and m, respectively. The energy flux of the high-energy electron-photon component in the core fluctuates remarkably, and the ratio of the maximum value to the minimum value is greater than 100 in the showers of the same size. The integral energy spectrum of the electron-photon component can be expressed by $E^{-(1.5\pm0.1)}$ at 2 to 50 Bev. (auth)

18306 THE ENERGY SPECTRUM AND THE ENERGY BALANCE OF COSMIC RADIATION. Hiroo Komori (Yamanashi Univ., Kofu, Japan). J. Phys. Soc. Japan, 17: 620-9(Apr. 1962). (In English)

The cut-off rigidity depends on the geomagnetic latitude and longitude; the energy balance of cosmic rays at Saskatoon (geomagnetic latitude 60.5°, geomagnetic longitude 311.9°), Minneapolis (55.2°, 330.9°), San Angelo (41.3°, 317.3°), and Guam (3.6°, 212.9°) was analyzed. Adopting the revised energy spectrum and the altitude variations of intensities and taking account of the underestimation of energy dissipated by the nuclear disintegration, there is agreement between the incident energy and the energy dissipated in the atmosphere at any place. (auth)

18307 OUTER VAN ALLEN BELTS AND NEUTRAL POINTS ON INTERFACE BETWEEN SOLAR WIND AND GEOMAGNETIC FIELD. C. C. Chang (Aerospace Corp., El Segundo, Calif.). Nature, 194: 424-6(May 5, 1962).

A physical model of a trapping mechanism for high energy particles from solar wind in the outer belts is suggested and the possible mechanism of boosting up the energy levels of the trapped particles in the outer belts is discussed. It is felt that a pair of netural points (N-1) are believed to be the key mechanisms of trapping high energy particles in the outer Van Allen belts. Their neighborhoods allow the solar wind plasma to seep into the geomagnetic field without reflexion. Their instability causes the connected interface to oscillate locally, inducing magnetohydrodynamic waves, which increases the energy of the trapped particles in succeeding steps to much higher levels. Even when the solar wind is not steady, these conclusions are expected to be valid, except the interface may change its position. Furthermore, the mechanisms of trapped particles and boosting energy become more effective. (P.C.H.)

18308 ELECTRON-PHOTON ENERGIES IN EXTENSIVE AIR SHOWERS. J. R. Green and J. R. Barcus (Univ. of New Mexico, Albuquerque). Nuovo cimento (10), 23: 708-23(Feb. 16, 1962). (In English)

Average electron and photon energies are found at various distances from the cores of extensive air showers by comparing the multiplicities produced under different thicknesses of lead and of water absorbers as measured using two large scintillators. For distances from $2.3 \cdot 10^{-2}$ to $1.4 \cdot 10^{-1}$ shower units from the cores of showers of 10^5 to 10^7 particles, the total energy carried by electrons and photons per electron is 61 $(r/r_2)^{-0.74}$ Mev per electron. The ratio of the average photon energy to the average electron energy is 1.5 to 3.3, at different distances. Transition curves obtained using different thicknesses of water as the absorber are used to show that for showers of $4.6 \cdot 10^4$ particles, $1.5 \cdot 10^{12}$ ev is expended in the production of pions per nuclear interaction to give an inelasticity of 0.33. (auth)

18309 ZENITH ANGLE DISTRIBUTION OF EXTENSIVE AIR SHOWERS. J. R. Green and Don D. Laniewski (Univ. of New Mexico, Albuquerque). Nuovo cimento (10), 23: 724-8 (Feb. 16, 1962). (In English)

Electron tracks obtained in a cloud chamber, triggered by a large scintillator, are analyzed to obtain the zenith angle dependence of the cores of extensive air showers. A cosine power law gives a reasonable fit with an exponent of 7.6. A better fit is obtained using the exponential absorption law $\exp[-(x_0/\lambda)(\sec\theta - 1)]$. Fitting the moments of the observed angles to this distribution leads to an absorption length of $\lambda = 144$ g/cm^2. These results apply at 1575 m for showers of 10^5 to 10^6 particles. (auth)

18310 EXTENSIVE AIR SHOWERS AND THE CHARACTERISTICS OF HIGH-ENERGY NUCLEAR INTERACTIONS AT AND ABOVE 10^{14} eV. A. Ueda and C. B. A. McCusker (Univ. of Sydney). Nuovo cimento (10), 23: 877-90(Mar. 1, 1962). (In English)

Characteristics of extensive air showers were deduced using the cascade model of Ueda and McCusker (Nuclear Phys., 26: 35(1961)), which contains certain assumptions regarding nuclear interactions at high energies. These have previously been successful in explaining the energy spectra of various components. It has also been assumed that all primary particles are protons having an incident energy spectrum represented by a power law. The model can predict the zenith angle dependence at sea level and mountain altitudes, the size dependence of nuclear-active particles of energy greater than a given (low) value, the

change in slope of the size spectrum at sea level, the near independence of the attenuation length on shower size, and the energy spectrum of nuclear-active particles. Suggestions are made for the improvement of the model. (auth)

18311 ALTITUTE DEPENDENCE OF THE LONGITUDINAL DISTRIBUTION OF ATMOSPHERIC ČERENKOV RADIATION. Forrest I. Boley, John A. Palsedge, and James H. Baum (Wesleyan Univ., Middletown, Conn.). Phys. Rev., 126: 734-5(Apr. 15, 1962).

The longitudinal distribution of the Cherenkov radiation generated by the electron component of extensive cosmic ray air showers interacting with the earth's atmosphere is measured at −46 and 3801 m elevation. Although the two distributions are similar, a somewhat larger number of showers with small Cherenkov radiation thickness at 3801 m suggests that those showers contain substantial light contributions from elevations where electron scattering is small. (auth)

18312 GENERAL APPROACH TO THE ELECTROMAGNETIC ORIGIN OF COSMIC-RAY ENERGY. W. F. G. Swann (Bartol Research Foundation, Swarthmore, Penna.). Phys. Rev., 126: 757-62(Apr. 15, 1962).

If, in an assigned piece of matter, the energy of motion, chemical energy, or even nuclear energy is shared among all the nucleons, there cannot amount to more than a small fraction of 10^9 ev for each nucleon. Hence the acquirement of cosmic-ray energies must invoke processes by which a small amount of matter steals from a much larger amount of matter energy, which it stores up for subsequent conversion into cosmic-ray energy. By setting up electric currents with their accompanying magnetic fields within itself, a small quantity of matter can hoard an amount of energy which, estimated per nucleon, can readily yield cosmic-ray energies. The general theorem relating rate of diminution of electromagnetic energy to rate of doing work on the particles and to the Poynting flux leads to the conclusion that if the energy of such an electromagnetic field can be caused to disappear, the whole of it must go into cosmic-ray energies of the particles, apart from that involved in the Poynting flux to infinity, which part, in certain cases, can be small. The destruction of the electromagnetic energy can be shown to occur in general by the spre ng out of the system concerning as a result of its normal dynamical activities. The matter is illustrated by considering the case of a ring of gas shot out from a region of primary magnetic field. The ring carries the magnetic flux with it, and the corresponding electromagnetic energy subsequently disappears by the expansion of the ring to infinite size with an accompanying conversion of the energy into cosmic-ray energies of the nucleons. (auth)

18313 COMPOSITION OF NUCLEAR ACTIVE PARTICLES WITH MOMENTA ABOVE 1.8 Bev/c IN THE COSMIC RADIATION AT AN ALTITUTE OF 3250 m ABOVE SEA LEVEL. A. V. Khrimyan, V. V. Avakyan, N. A. Nalbandyan, K. Sh. Egyan, and M. P. Pleshko (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 669-74(Mar. 1962). (In Russian)

The nature and momentum spectra of nuclear cosmic particles are studied in the atmosphere at 3250 m above sea level with a magnetic mass-spectrometer and a five-layer proportional counter. In the momentum range 100 to 720 Mev/c the ratio $N_{\pi^+}/N_{\pi^-} = 0.90 \pm 0.15$ is obtained for the particle flux. Pions comprise about 5% of all particles in the 1.8 to 22 Bev/c momentum range and not more than 10% of the particles with momenta ≥ 1.8 Bev/c. (auth)

18314 ON μ-MESON BEAMS IN BROAD AIR SHOWERS. S. N. Vernov, Li Don Hua, B. A. Khrenov, and G. B. Khristiansen (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 758-69(Mar. 1962). (In Russian)

An investigation of irregularities in the spatial distribution of μ meson beams in broad atmospheric showers is presented. The distribution of meson tracks in the observation plane is analyzed by the Monte Carlo method. The existence of narrow beams of groups of μ mesons is confirmed. The spectrum of the broad atmospheric showers accompanying these beams is obtained. The possibility of production of μ meson beams in nuclear interaction events is discussed. (auth)

Criticality Studies

Refer also to abstracts 18158 and 18159.

18315 (HW-71666) NUCLEAR SAFETY AND CRITICALITY OF PLUTONIUM. E. D. Clayton and W. A. Reardon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1961. Contract AT(45-1)-1350. 86p.

The data and techniques which were used to evaluate the criticality problems in typical Pu processing plants are presented. Recommendations concerning the reliability of the data, and techniques of control are also discussed. (J.R.D.)

18316 CRITICALITY OF LOW ENRICHMENT URANIUM IN HYDROGEN. C. B. Mills and G. I. Bell (Los Alamos Scientific Lab., N. Mex.). Nuclear Sci. and Eng., 12: 469-73(Apr. 1962).

Critical masses of homogeneous water-moderated assemblies containing low enrichment uranium are given. The calculations were made using the multigroup DSN code with eighteen energy groups. Effective absorption cross sections for U^{238} were computed with the infinite mass and narrow resonance approximations. The calculations were compared with various experiments and rather good agreement was found. The results are presented as a parametric survey for U^{235}/U atom ratios from 0.014 to 0.300 and for all H/U^{235} ratios for which criticality is possible. The decrease in critical radius with an infinite water reflector is also shown. A bare homogeneous system with $U^{235}/U < 0.010$ cannot be made critical at any H/U^{235} ratio. (auth)

Elementary Particles and Radiations

Refer also to abstracts 18099, 18100, 18101, 18102, 18119, 18166, 18168, 18170, and 18172.

18317 (AD-265526) PERTURBATION THEORY OF PION–PION INTERACTION. I: RENORMALIZATION. Technical Report No. 346. Tai Tsun Wu (Harvard Univ., Cambridge, Mass. Cruft Lab.). Aug. 30, 1961. Contract Nonr-1866(32). 61p.

The problem of the pion-pion scattering is studied on the basis of the model of a four-particle direct interaction without derivative coupling. Renormalization is carried out for this model with a detailed analysis of overlap insertions. To every finite order in the renormalized coupling constant, it is shown that the unitarity relation holds and that the Feynman integral representation is still

valid, and hence renormalization has no effect on analytic properties. (auth)

18318 (AFOSR-1568) CORRECTION TO INTRINSIC MAGNETIC MOMENTS BY CENTRAL AND TENSOR FORCES. Technical Note No. 26. B. Bremond (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de Physique Théorique et Hautes Energies). June 1961. Contract AF 61(052)-173. 20p. (AD-266561)

The magnetic moment correction by central and tensor interactions between a nucleon of specific momentum and spin and the Fermi sea are studied. The intrinsic magnetic moment operator is stated. The correction value is calculated by a second order perturbation method. The results are in qualitative agreement with the doubly-magic-plus-or-minus-one nuclei magnetic moments. (auth)

18319 (AFOSR-2117) A FIELD-THEORETICAL CALCULATION OF THE ONE-PION-EXCHANGE AND TWO-PION-EXCHANGE CONTRIBUTIONS TO THE PHASE-SHIFTS WITH HIGHER ANGULAR MOMENTA FOR NUCLEON–NUCLEON SCATTERING. Technical Report No. 238. Iwao Sato (Maryland. Univ., College Park). Jan. 1962. Contract AF49(638)-24. 44p.

The one-pion-exchange and two-pion-exchange parts of the S-matrix for nucleon-nucleon scattering are calculated field-theoretically. The rescattering of virtual pions by nucleons and the pion-pion interaction between virtual pions are taken into account. The S-matrix is then decomposed into the partial-wave amplitudes, and the phase shifts are calculated. Numerical evaluations are carried out for the 310-Mev proton-proton scattering, and the results are compared with the phase shifts obtained by analyzing the experimental data. It is found that, without contribution of the pion-pion interaction, the results are far from agreement with experiment because of too strong attraction arising from the contributions of the two-pion-exchange part, but the contribution of the pion-pion resonance in the $I = J = 1$ state improves the results considerably by largely cancelling the attraction. It is, however, also found that definite discrepancies still remain between the theory and the experiments, and this suggests that some unknown effects must play important roles in determining the nuclear force in the region of the internucleon distance around the Compton wave length of the pion. (auth)

18320 (INSJ-48) ON THE MULTIPLE MESON PRODUCTION. S. Hasegawa (Tokyo Univ. Inst. for Nuclear Study). Feb. 20, 1962. 75p.

A summary is presented of the basic behavior characteristics related to explosive meson production in high-energy nuclear interactions. The multiple meson production takes place through a new quantum (H) which bears a phenomenological resemblance to the composite system of a baryon and an anti-baryon. (J.R.D.)

18321 (NYO-10130) EFFECT OF PION RESONANCES ON THE $(\pi^+ - \pi^0)$ AND $(K^+ - K^0)$ MASS DIFFERENCES. S. K. Bose and R. E. Marshak (Rochester, N. Y. Univ.). Mar. 5, 1962. Contract AT(30-1)-875. 8p.

The electromagnetic form factor of pions and kaons, obtained on the basis of the experimentally observed pion and K-π resonances, are fed into the known dispersion-theoretic formula relating the mass difference to the form factors. It is observed that the $(\pi^+ - \pi^0)$ mass difference is completely explained on the basis of the 2π resonance at 750 Mev in the $J = 1$, $T = 1$ state. The sign and magnitude of $(K^+ - K^0)$ mass difference could be explained if one expects corresponding restrictions on the isoscalar part of the kaon form factor. (auth)

18322 (UCRL-9951) DETERMINATION OF π-MESON MASSES BY NEUTRON TIME OF FLIGHT (thesis). John B. Czirr (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 19, 1962. Contract W-7405-Eng-48. 55p.

Time-of-flight techniques were used to measure the velocities of the neutrons from the reactions, at rest, $\pi^- + p \rightarrow n + \pi^0$ and $\pi^- + p \rightarrow n + \gamma$. From these velocities the π^- mass and the $\pi^- - \pi^0$ mass difference were obtained, yielding the values $m_{\pi^-} = 139.69 \pm 0.29$ Mev/c^2 and $m_{\pi^-} - m_{\pi^0} = 4.6064 \pm 0.0030$ Mev/c^2. The velocity distribution about the mean velocity was measured and found to have an rms deviation of $(8.7 \pm 0.7) \times 10^6$ cm/sec. Negative π mesons from the Lawrence Radiation Laboratory 184-in. synchrocyclotron were degraded by 33 g/cm^2 of carbon and stopped in a 1-in.-high liquid hydrogen target. The neutrons were detected in a 1-in.-thick plastic scintillator viewed by seven RCA 7046 photomultiplier tubes. Neutron times of flight were measured over distances of 17 ft, 47 ft, and 67 ft. Time was measured for each event from the time of detection of a γ ray associated with that event (one of the γ rays from the reaction $\pi^0 \rightarrow 2\gamma$ in the case of the low-energy neutron). The γ-detector signal was delayed and photographed along with the neutron signal on an oscilloscope trace. (auth)

18323 (JPRS-13043) SOME PROBLEMS OF THE INTERACTION OF CHARGED PARTICLES WITH AN ELECTRIC FIELD. G. M. Gershtein (Gershteyn). Translated from "Nektoroye Voprosy Vzaimodeystviya Zaryazhennykh Chastits s Elektricheskim Polem." p.1-165, Saratov, 1960. 297p.

The fundamental processes involved in the interactions between charged particles and alternating electric fields in generators, amplifiers, accelerators, and other devices are described. Particular attention is paid to sorting-out of particles in a beam, induced currents, and the connection between the spatial distribution of the field and the variation of the induced current with time. A method for simulating the electric field is proposed which is based on the Shockley-Ramo theorem. Processes involving particle sorting are analyzed for generators and amplifiers with static and dynamic control and for charged-particle accelerators. The possibility of using space-charge waves to explain the mechanism of non-resonant oscillations is considered. (D.L.C.)

18324 (UCRL-Trans-807) ON K-MESON-HYPERON RESONANCES. (O K-Mezon-Giperonnykh Rezonansakh). A. I. Baz', V. G. Vaks, and A. I. Larkin (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). Translated by M. Kassatkin (Univ. of California Lawrence Radiation Lab., Berkeley). 1962. 38p. (Includes original, 20p.).

On the basis of the data on the distribution of the cross sections for $\pi^- + p \rightarrow \Sigma + K$ and $\pi^- + p \rightarrow \Lambda + K$ in the vicinity of the $\Sigma + K$ threshold, it was concluded that there possibly exists a level in the $\Sigma + K$ system at $T = \frac{1}{2}$ with the binding energy $E \sim 30$ Mev, which must lead to a resonance in the reaction $\pi^- + p \rightarrow \Lambda + K$ below the threshold $\Sigma + K$. The possibility of the existence of such levels in $\Lambda + K$, as well as in some other systems, and their connection with resonances in the vicinity of the corresponding thresholds is discussed. (auth)

18325 RELATIVISTIC QUANTUM THEORY AS A GROUP PROBLEM. II. WORLD GEOMETRY AND THE ELEMENTARY PARTICLES. Y. Ahmavaara. Ann. Acad. Sci. Fennicae. Ser. A, VI, No. 95, 1-51(1962). (In English)

The world geometry underlying the theory of elementary particles is investigated. The elementary, non-relativistic

geometry of the physical space is given a general formulation, sufficient to yield the quanta of momentum and energy when the group quantization process is applied to the physical space. The elementary geometry is represented by a commutative (finite or continuous) group of translations to which Pontrjagin's theorem concerning the duality between a commutative group and its character group applies. The principle of uncertainty is given a group theoretical formulation in terms of the Pontrjaginian duality. This formulation allows a consequent and meaningful extension of quantum theory to a finite geometry. The role of the relativistic (finite or continuous) geometry of space-time in the theory of elementary particles is investigated. A formulation of the problem of elementary particles is given, and an eventual connection between the observed elementary particles and a geometry of the Lorentz group space is suggested. (auth)

18326 A SET OF INTEGRAL EQUATIONS FOR THE PHOTOPRODUCTION OF PIONS ON NUCLEONS AMPLITUDES. [PART] I. G. Bialkowski and A. Jurewicz (Univ. of Warsaw). Bull. acad. polon. sci., Ser. sci., math., astron. et phys., 10: 49-55(1962). (In English)

A symmetrization of the amplitudes in the process $\gamma + N \rightarrow \pi + N$ is performed by deriving integral equations from the Cauchy representation and considering locations of singularities in the complex planes. In considering only the nearest singularities in the complex planes, equations for the photoproduction amplitudes containing no contributions from the reaction $\gamma + \pi \rightarrow N + \bar{N}$ are obtained and numerical results are possible. States with a baryon number of 0 influence the amplitudes only by amplitudes of the process $\pi + N \rightarrow \pi + N$, which occur in the unitarity condition and are obtained by experiment. (L.N.N.)

18327 THE SELECTION RULE $\Delta T = \frac{1}{2}$ AND HYPERFRAGMENT DECAYS. V. A. Lyul'ka. Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 6, 90-4(1961). (In Russian)

An analysis is made of the applicability of the $\Delta T = \frac{1}{2}$ rule for weak interactions and of the decay of hyperfragments. Additional ratios were derived for the probabilities of hyperfragment decay according to various channels. Various types of ${}_{\lambda}He^{4}$, ${}_{\lambda}H^{4}$, ${}_{\lambda}He^{5}$, ${}_{\lambda}Li^{7}$, and ${}_{\lambda}Be^{9}$ decay were examined. (R.V.J.)

18328 MASS DOUBLET FIELDS. K. H. Tzou (Institut Henri-Poincaré, Paris). J. phys. radium, 22: 795-800 (Dec. 1961). (In French)

Symmetrically self-coupled fields can be defined for all spins with respect to all eight unitary inversions. Such fields are also realizable with respect to the eight anti-unitary inversions in the case of integer spins, but are realizable only with respect to C and PTM in the case of half-odd-integer spins. Each such field has two states of different rest-mass. Some physical arguments exclude the physical reality of all such fields defined with respect to the eight M-independent inversions, while those defined with respect to the eight M-dependent inversions are quite admissible in the physical point of view. However, some particular and well specified physical systems can quite well be represented by certain of the self-coupled fields which are defined even with respect to the M-independent inversions. In the framework of this theory, the M-symmetrically self-coupled fermion field is proposed for the leptonic M-doublets, electron-muon and neutrino, and the C (or CP) symmetrically self-coupled boson field represents the mesonic C (or CP) doublet K_1^0-K_2^0. (auth)

18329 CALCULATION OF THE PROPORTION OF FORBIDDEN COLLISIONS IN THE INTERACTIONS BETWEEN π^- MESON AND BOUND PROTON AT 5.0 Bev ENERGY. Claude Bastard, Jean Grea, Joseph LaFoucrière, and George Philbert (Institut de Physique Nucléaire, Faculté des Sciences, Lyon). J. phys. radium, 22: 801-6 (Dec. 1961). (In French)

The ratio of elastic collisions forbidden in interactions between π and bound proton at 5.0 Bev energy is calculated. The basic hypotheses are the following: (1) The cross section of elastic scattering π^--bound p is equal to cross section π^- free proton. (2) The energy distribution of intranuclear protons is that of Fermi gas at 0°K temperature. Two methods are used. The first one utilizes a continuous variation of collision parameters; the other is a Monte-Carlo method. Both give results in a satisfactory agreement and the proportion of forbidden collisions is equal to 0.17. (auth)

18330 BRANCHING RATIO BETWEEN THE VARIOUS DECAY MODES OF THE Mu MESON. Alix Jacquemin and Paul Kessler (Collège de France, Paris). J. phys. radium, 22: 824-6(Dec. 1961). (In French)

Using the method of quasi-real processes, the branching ratios between the three observed decay modes of the mu meson were calculated: $\mu \rightarrow e + \nu + \bar{\nu}$, $\mu \rightarrow e + \nu + \bar{\nu} + \gamma$, and $\mu \rightarrow e + \nu + \bar{\nu} + e^- + e^+$. These branching ratios are functions of the threshold energy of the emitted photon or the pair created. The results are in rough agreement with the recent experimental measurements of Crittenden, Walker, and Ballam. (auth)

18331 DISTRIBUTION OF GAMMA RADIATION FROM A ^{60}Co SOURCE IN WATER. Kenji Ishimatsu (Hitachi Central Research Lab., [Japan]). Nippon Genshiryoku Gakkaishi, 4: 175-9(Mar. 1962). (In Japanese)

Measurements were made of gamma distribution from a point source of Co^{60} in an infinite water medium. Energy flux spectra were measured by a scintillation spectrometer for penetration distances between 5.49 and 12.8 mean free path, while dose rates were measured by ionization chambers for distances between 0.610 and 2.75 mean free path. Satisfactory agreement was obtained between dose buildup factors given by the experimental results and those given by the calculated moment method. A slight discrepancy seemed to exist between the experimental energy flux spectra and the calculated ones. (auth)

18332 ON THE UNIVERSALITY OF WEAK INTERACTIONS. D. Itô, S. Ragusa, and A. H. Zimerman (Instituto de Física Teórica, São Paulo, Brazil). Nuovo cimento (10), 23: 461-76(Feb. 1, 1962). (In English)

In classical physics the electromagnetic interactions can be introduced, because of their universality, by the formal procedure: $p_\mu \rightarrow p_\mu - (e/c)A_\mu$. The universal gravitational interaction is introduced formally as a change in metric: $\delta_{\mu\nu} \rightarrow g_{\mu\nu} = \delta_{\mu\nu} + \chi_{\mu\nu}$. In analogy with these classical examples of universal interactions, the universal leptonic interactions are introduced by replacing baryonic currents J_μ, Y_μ (strangeness-conserving and violating currents) and boson-field operators $\partial_\mu\pi$ and $\partial_\mu K$ appearing in the non-leptonic interaction Lagrangian: $\mathcal{L} = l\,[J_\mu^+\partial_\mu K + Y_\mu^+\partial_\mu\pi + \text{h.c.}]$ by $J_\mu \rightarrow J_\mu + \alpha L_\mu$, $Y_\mu \rightarrow Y_\mu + \beta L_\mu$, and $\partial_\mu\pi \rightarrow \partial_\mu\pi + \alpha r_0 L_\mu$, $\partial_\mu K \rightarrow \partial_\mu K + \beta r_0 L_\mu$, where $L_\mu = [(\bar{e} + \bar{\mu})\,\gamma_\mu(1 + \gamma_5)\nu]$ is the leptonic current, $r_0 = 1.4 \times 10^{-13}$ cm; α and β are constants which can be determined as $\alpha = \frac{1}{4}$ and $\beta = 1$. Almost all leptonic interactions are introduced by this formal procedure, and the predictions from the new Lagrangian are compared with experiments. The small probabilities of the leptonic decays of hyperons are reproduced by the new Lagrangian. (auth)

18333 SEARCH FOR THE DECAY $\mu^+ \rightarrow e^+ + e^- + e^+$. S. Parker and S. Penman (Univ. of Chicago). Nuovo cimento (10), 23: 485-501(Feb. 1, 1962). (In English)

A search for $\mu^+ \rightarrow e^+ + e^- + e^+$ was conducted using counter techniques. The number of mesons stopped was 10^9; when multiplied by the efficiency for detecting a three-electron decay, the number became 1.7×10^7. Five events were seen and are probably due to the decay mode $\mu^+ \rightarrow e^+ + e^- + e^+ + \nu + \bar{\nu}$. Even assuming them to be due to $\mu^+ \rightarrow e^+ + e^- + e^+$, an upper limit of 5×10^{-7} is set for the branching ratio of this mode. (auth)

18334 PRELIMINARY DETERMINATION OF Σ-Λ PARITY USING POLOLOGY. S. Iwao (Syracuse Univ., N. Y.). Nuovo cimento (10), 23: 516-25(Feb. 1, 1962). (In English)

An expression for the normalization of the T-matrix pole term is given. The method of pology is applied to various processes. The coupling constant of the NAK interaction is determined from the $\bar{p} + p \rightarrow \Lambda + \bar{\Lambda}$ angular distribution. Further application of the method to Σ^0-K^0 production from π^--p interactions and $\Sigma^- + \pi^+$ production from K^- + p interactions indicate that the Σ-Λ relative parity is even, although this conclusion is uncertain. This constitutes support for the hypothesis of global symmetry. Additional applications of pology are suggested and discussed. (auth)

18335 THE PION-PION EFFECT ON LOW-ENERGY PION-NUCLEON SCATTERING. M. Marinaro (Istituto di Fisica Teorica, Naples) and K. Tanaka. Nuovo cimento (10), 23: 537-46(Feb. 1, 1962). (In English)

The pion-pion resonance contribution to low-energy pion-nucleon scattering was obtained in closed form by integrating over the circle that characterizes the π-π cut. Its effects on the S-wave amplitude and on the isotopic spin-flip contributions of S- and P-wave amplitudes in π-N scattering were studied. The approach differs from a phenomenological method in that control and understanding of the nature of the singularities included in the calculation are possible. When the isotopic spin-flip S-wave amplitude in π-N scattering is extrapolated from physical to unphysical values of the square of the total energy, a smooth energy dependence is found in the unphysical region. The π-π contributions to $S_{\frac{1}{2}}$ and $P_{\frac{1}{2}}$ states of π-N are related by a mass reversal. (auth)

18336 CONVERGENCE OF PERTURBATION EXPANSIONS IN MESON THEORIES WITHOUT VACUUM POLARIZATION. I. Bialynicki-Birula (Univ. of Rochester, N. Y.) and W. M. Frank. Nuovo cimento (10), 23: 547-55(Feb. 1, 1962). (In English)

It is shown for cut-off meson theories with Yukawa coupling and no vacuum polarization that the perturbation expansion of the resolvent operator $(H + \Omega)^{-1}$ converges and is analytic in Ω for all complex and sufficiently positive real Ω. A consequence is the boundedness of the spectrum from below. Convergence of the renormalization constants is demonstrated. The method used is that of comparison with the exactly-solvable neutral scalar model. (auth)

18337 POLE APPROXIMATION FOR NONLEPTONIC AND RADIATIVE HYPERON DECAYS WITH ODD Σ-Λ RELATIVE PARITY. S. K. Bose and R. E. Marshak (Univ. of Rochester, N. Y.). Nuovo cimento (10), 23: 556-63 (Feb. 1, 1962). (NYO-9537). (In English)

The pole approximation for the non-leptonic decay modes of the hyperon is examined from odd Σ-Λ relative parity. The method is applied to the study of hyperon radiative decay modes. (auth)

18338 POSITRON ANNIHILATION IN NEUTRON-DAMAGED ANTHRACENE. G. Fabri and E. Germagnoli (C.I.S.E., Milan). Nuovo cimento (10), 23: 572-9(Feb. 1, 1962). (In English)

The positron lifetime and the angular correlation between annihilation γ rays were measured in neutron-damaged and non-damaged anthracene single crystals. Results suggest that positronium is formed in damaged anthracene in a manner similarly to that in liquid anthracene, while it is not formed in the non-damaged material. The lifetime in neutron-disordered anthracene is 7.6×10^{-10} sec, and the angular correlation between 0.511-Mev γ rays is modified by irradiation. (auth)

18339 THE ROLE OF $\tau\gamma_5$-GAUGE INVARIANCE IN A NONLINEAR MODEL OF ELEMENTARY PARTICLES. H. Banerjee (Université, Geneva). Nuovo cimento (10), 23: 587-97(Feb. 1, 1962). (In English)

The role of $\tau\gamma_5$-gauge invariance in the theory of elementary particles proposed by Y. Nambu and G. Jona-Lasinio (Phys. Rev. 122: 345(1961); 124: 246(1961)) was examined in the framework of the lowest ladder approximation. It was shown that the invariance property is not necessary for proving the vanishing of the pion mass. The integral equation for the axial vector vertex part needs modification if the solution is to represent the vertex part of a conserved axial vector current. (auth)

18340 ON THE CONSISTENCY OF THE COUPLED S AND P-WAVE SOLUTIONS IN PION-PION SCATTERING. B. H. Bransden (The University, Glasgow) and J. W. Moffat. Nuovo cimento (10), 23: 598-605(Feb. 1, 1962). (In English)

The asymptotic behavior of partial-wave scattering amplitudes in pion-pion scattering is investigated in relation to the role of the double spectral functions. Because of the insensitivity of the low-energy theory to the distant left-hand discontinuity, the solutions obtained in the low-energy region are independent of the existence of a cut-off. Results of a calculation of the double spectral functions in the two-pion intermediate state approximation are described. The consistency of the inverse amplitude solutions with crossing symmetry is examined, and a calculation of the P-wave solution is described using the N/D method. It is shown that if real ghost poles appear on the left cut in the P-wave solutions, these poles will occur well beyond the region of validity of the approximations. (auth)

18341 TIME REVERSAL AND SUPERSELECTION. H. Ekstein (Argonne National Lab., Ill.). Nuovo cimento (10), 23: 606-15(Feb. 1, 1962). (In English)

Physical requirements on the time-reversal operator are reformulated in terms of observables and proper states. These requirements entail superselection rules that are consistent with experiment. (auth)

18342 PROPERTIES OF THE S-MATRIX AS A FUNCTION OF THE COMPLEX ANGULAR MOMENTUM FOR THE MANY-CHANNEL CASE AND FOR THE DIRAC EQUATION. L. Favella and M. T. Reineri (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo cimento (10), 23: 616-40(Feb. 1, 1962). (In English)

A study of the analytical behavior of the potential scattering amplitude at fixed real energy in the complex plane of the angular momentum was made in correspondence to a Dirac equation of motion and a Schrödinger's many-channel problem. The boundary of the region in which the singularities are located was determined. In the many-channel case, the poles are confined to a strip parallel to the imaginary axis. (auth)

18343 SOME SIMPLE INEQUALITIES IN SCATTERING BY COMPLEX POTENTIALS. A. Martin (CERN, Geneva). Nuovo cimento (10), 23: 641-54(Feb. 1, 1962). (In English)

If the range of the imaginary part of a complex potential is not too small compared to the range of the real part of the potential, inequalities between total absorption, and elastic cross-sections can be derived using the Schwarz inequality. This holds for the whole process and for a given partial wave. Upper and lower bounds of the cross-sections are obtained. The elastic cross-section decreases faster with angular momentum than the absorption cross-section. Whether or not this result holds when these conditions are released is investigated. Dependence on the specific shape of the potential is found. For a strictly finite range potential, this result holds, but for Yukawa-shaped potentials at sufficiently high energy, the absorption cross-section decreases faster with increasing angular momentum than does the elastic cross-section if the range of the imaginary potential is less than half the range of the real potential. (auth)

18344 A NOTE ON THE REACTION $\pi^+ + d \rightarrow p + p$. E. G. Beltrametti (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo cimento (10), 23: 655-8 (Feb. 1, 1962). (In English)

Methods of distinguishing contributions of pionic S and p waves in the reactions $\pi^+ + d \rightarrow p + p$ and $\pi^- + d \rightarrow n + n$ below the $^3/_2$, $^3/_2$ resonance energy are considered. Amplitude phenomenological determination for the three possible final states is discussed. (L.N.N.)

18345 PION RESONANT STATES. R. D. Hill (Univ. of Illinois, Urbana). Nuovo cimento (10), 23: 659-60(Feb. 1, 1962). (In English)

Empirical regularities in resonant-state energy properties are considered. A model in which π resonant states should possess quadrupole moments is presented. Calculations and data are presented in tabular form. (L.N.N.)

18346 ANGULAR DEPENDENCE OF POLARIZATION IN p-p ELASTIC SCATTERING AT 970 Mev. R. J. Homer, W. K. McFarlane, A. W. O'Dell, E. J. Sacharidis, and G. H. Eaton (Univ. of Birmingham, Eng.). Nuovo cimento (10), 23: 690-6(Feb. 16, 1962). (In English)

The angular dependence of polarization in p-p elastic scattering was measured at 970 Mev. Results agree qualitatively with measurements at 0.635 and 1.7 Bev and indicate that a Gammel-Thaler type spin-orbit potential is unsatisfactory at these energies. A least squares fit to the data gave $\sigma(\theta)\, E(\theta) = \sin\theta \cos\theta \{(0.70 \pm 0.04) P_0(\cos\theta) + (1.56 \pm 0.12) P_2(\cos\theta) + (0.45 \pm 0.14) P_4(\cos\theta)\}$ mb/sr, where $\sigma(\theta)$ and $E(\theta)$ are the unpolarized differential cross section and the measured asymmetry as functions of θ(c.m), respectively. The maximum observed polarization in p-p scattering is close to 40% at 48° (cms). (auth)

18347 A COMMENT ON THE Σ-Λ PARITY AND RESOLUTION BETWEEN THE BOUND STATE MODEL AND THE ISOBAR MODEL OF Y_1^*. S. Iwao (Syracuse Univ., N. Y.). Nuovo cimento (10), 23: 784-6(Feb. 16, 1962). (In English)

The importance of Λ-p inelastic interactions for determination of Σ-Λ relative parity and interpretation of Y_1^* is discussed. The p-p inelastic interactions for 1-π production can be explained by the 1-π exchange model if a suitable account of 3,3 resonance, vertex, and propagator corrections is given. This method is used to describe Λ-p interactions, and predictions are made. The predictions are tested, and conclusions are discussed. (L.N.N.)

18348 SOME REMARKS ON THE RELATIVISTIC TWO-BODY EQUATION. L. Bertocchi (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna), S. Fubini, R. Stroffolini, and M. Tonin. Nuovo cimento (10), 23: 789-99(Mar. 1, 1962). (In English)

An attempt is made to obtain a solution of the relativistic two-body equation by a method used in the nonrelativistic case. A simple solution, valid for small binding is obtained, and its relation to the Schrödinger problem is discussed. (auth)

18349 THE QUANTUM NUMBERS OF THE ω-MESON. H.-P. Duerr and W. Heisenberg (Max-Planck-Institut für Physik und Astrophysik, Munich). Nuovo cimento (10), 23: 807-16(Mar. 1, 1962). (In English)

In the analysis of data concerning the 3-pion resonance state, called ω-meson, the G-parity is an important quantum number. Eight states with spin < 2 are present. Only the symmetries 0^{-+} and 1^{-2} seem compatible with available material. The Dalitz plot slightly favors the symmetry 1^{-2}; the small width of the ω-resonance line slightly favors 0^{-+}. A decision can probably be reached by studying the ratio $R = (\omega \rightarrow \text{neutrals})/(\omega \rightarrow \pi^+ + \pi^- + \pi^0)$, which should be very small for 1^{-2}, but of the order of unity for 0^{-+}. If further experiments confirm the indications that the disintegration of ω into neutral particles is essential, the symmetry 1^{-2} would be ruled out. (auth)

18350 ANALYTIC STRUCTURE OF THE SCATTERING MATRIX IN THE NEUTRAL PSEUDOSCALAR THEORY. G. Wanders (Université, Lausanne, Switzerland). Nuovo cimento (10), 23: 817-37(Mar. 1, 1962). (In English)

A representation for the general solution of the one-meson approximation of the Low equation in the neutral pseudoscalar static model is given. This representation exhibits the analytic structure of the scattering matrix on its whole Riemann surface. The connection between resonances and poles in the first unphysical sheet is studied for a special class of solutions. (auth)

18351 ππ INTERACTION IN FINAL STATE PROCESSES. M. Jacob (Centre d'Etudes Nucléaires, Saclay, France), G. Mahoux, and R. Omnès. Nuovo cimento (10), 23: 838-47(Mar. 1, 1962). (In English)

A method is proposed for considering final state interactions in processes producing two pions. This method is applied to the analysis of the T = 0 pion-pion interaction in the reaction $p + d \rightarrow He^3 + 2\pi$. It is shown that the anomaly observed by Abashian, Booth, and Crowe can be explained assuming a π-π scattering length of the order of two-pion Compton wave lengths. (auth)

18352 INELASTIC λ-p SCATTERING. P. G. O. Freund (Universität, Vienna) and A. Fujii. Nuovo cimento (10), 23: 848-51(Mar. 1, 1962). (In English)

The process $\Lambda + p \rightarrow \Lambda + p + \pi^0$ is discussed in the peripheral approximation with special consideration of the Y^* resonance in π-Λ scattering. (auth)

18353 STATISTICAL THEORY RESULTS ON MULTIPLE PARTICLE PRODUCTION FROM π-N COLLISIONS AT 3 Gev. K. H. Michel (CERN, Geneva). Nuovo cimento (10), 23: 852-8(Mar. 1, 1962). (In English)

Spectra and mean particle numbers for all produced particles in 3-Bev π-N collisions are calculated according to a refined version of the Fermi model. The existence of π-N isobars and the conservation of isospin are taken into account, and unbiased values of the phase space integrals are used. Gamma spectra from π^0 decay are given. (auth)

18354 PRODUCTION OF $\bar{\Lambda}\Lambda$ PAIRS IN $\bar{N}N$ COLLISIONS. G. C. Summerfield (Michigan State Univ., East Lansing). Nuovo cimento (10), 23: 867-76(Mar. 1, 1962). (In English)

The production of $\bar{\Lambda}\Lambda$ pairs in $\bar{N}N$ collisions is considered using a Schrödinger equation with relativistic kinematics. Only the $\bar{\Lambda}\Lambda$ and $\bar{N}N$ channels are explicitly considered. The inclusion of imaginary parts in the interactio

potentials is used to account for the effects of scattering into other possible channels. A non-diagonal potential connecting the $\bar{\Lambda}\Lambda$ and $\bar{N}N$ channels is assumed to arise from the exchange of a single K meson. This results in coupled equations for the wave functions in the two channels. These equations are solved under the assumption that the non-diagonal potential does not distort the $\bar{N}N$ wave function. An expression for the differential cross section is derived assuming finite range but otherwise general potentials. This expression is evaluated at 0.8, 0.93, and 1.2 Bev for the incident anti-nucleons, using square-well potentials. The calculation is performed using a non-diagonal potential with a range of 0.4 Fermi, equal to the Kaon Compton wavelength, and a depth of 146 Mev, which agrees with the experimental value of the $\bar{\Lambda}\Lambda$ production cross section at 0.93 Bev. The angular distributions and energy dependence of the cross section are computed. The use of square wells introduces unrealistic diffraction scattering. However, the general method should give more reasonable behavior of the cross section if more realistic potentials are used. (auth)

18355 HEAVY-BODY POTENTIALS IN THE LEE MODEL. [PART] I. L. M. Scarfone (Florida State Univ., Tallahassee). Nuovo cimento (10), 23: 891-907(Mar. 1, 1962). (In English)

A study is made of the bound states for the V-2N sector in the Lee model. The energy eigenvalue problem yields an equation involving the particle separations, parity, energy, and the renormalized coupling constant. This equation contains terms which carry one, two, and three-body effects. Corresponding equations for the V-N and V sectors are generated by removing first one N and then the other. If the V-2N geometry is adjusted to an isosceles configuration, the eigenvalue equation factors into three possibilities that allow solutions along the lines of the V-N problem. Characteristic features of the model in this sector are the coincidence of even and odd parity V-N and V-2N potential energies, and the critical constant for the appearance of complex energies can be smaller or larger than the corresponding quantity in the two-body system. (auth)

18356 INTERPRETATION OF THE PION-HYPERON RESONANCES. R. C. Hwa and D. Feldman (Brown Univ., Providence). Nuovo cimento (10), 23: 914-18(Mar. 1, 1962). (In English)

The pion-hyperon resonances at 1520 and 1580 Mev were studied; they were considered as manifestations of the dynamic structure of the closed pion-hyperon system. For a suitable choice of coupling constant values, a consistent interpretation of all resonances observed is possible. (L.N.N.)

18357 THE DESCRIPTION OF SUPERFLUID FERMI SYSTEMS WITH ANISOTROPIC FEATURES. A. Klein (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo cimento (10), 23: 919-22(Mar. 1, 1962). (In English)

Means by which a system having an isotropic Hamiltonian can exhibit anisotropic features are considered. A degeneracy or near degeneracy of the spectrum with respect to angular momentum quantum numbers may be found. Conclusions favor results using a generalized Bardeen–Cooper–Schrieffer trial function not conserving numbers of particles nor total angular momentum (P. W. Anderson and P. Morel, Phys. Rev., 123: 1911(1961)). (L.N.N.)

18358 MAGNETIC MOMENTS OF HYPERONS. J. S. Levinger (Cornell Univ., Ithaca, N. Y.). Nuovo cimento (10), 23: 927-30(Mar. 1, 1962). (In English)

Hyperon magnetic moments are interpreted in terms of baryon coupling to the isoscalar mesons (η at 550 and ω at 790 Mev) and an isovector meson (ρ at 750 Mev). It is assumed that the η couples to the photon field, since this coupling is needed to fit the nucleonic form factors. An accuracy test of the vector theory of strong interactions is provided. (L.N.N.)

18359 SUBTRACTION CONSTANTS IN π-π → N-$\bar{N}$ DISPERSION RELATION. P. Menotti (University Coll., London). Nuovo cimento (10), 23: 931-3(Mar. 1, 1962). (In English)

A double subtraction is introduced in the dispersion relation for the helicity amplitude $f_t^0(t)$ in the reaction π-π → N-$\bar{N}$. A large relative error is introduced in a term, but it causes a small uncertainty in evaluation of the dispersion relation. The error is due to uncertainty in the p-wave scattering lengths. (L.N.N.)

18360 THEORY OF MANY-PARTICLE SYSTEMS. II. SUPERCONDUCTIVITY. Leo P. Kadanoff and Paul C. Martin (Harvard Univ., Cambridge, Mass.). Phys. Rev., 124: 670-97(Nov. 1, 1961). (AFOSR-2066)

A fermion system with a simple attractive interaction is discussed with the aid of time-dependent correlation functions. Although perturbation theory is inapplicable, a sequence of correlation approximations can be employed. The lowest approximation in the sequence expresses the two-particle correlation function in terms of single-particle functions and leads to the Hartree approximation; the second expresses three-particle correlation function in terms of one- and two-particle correlation functions and leads to the time-dependent correlation functions that characterize a superconducting model. The correlation functions are determined and the thermodynamic properties of the superconductor are calculated from them. The electromagnetic effects of the superconductor predicted by time-dependent correlation functions are considered. An unsatisfactory description of current conservation is indicated and overcome by a more accurate solution valid at nonvanishing temperature. This solution predicts different diffusive properties but the same Meissner effect and superconductive behavior, since the longitudinal current correlation function is modified while the transverse current correlation function is not. The properties of a pure superconductor which depend on the lifetimes of the single-particle excitations are also discussed. The effect of these lifetimes on the static electrical conductivity is determined, and it is shown that they do not destroy supercurrents although they eliminate a gap in the single-particle excitation spectrum. Their effect on the thermal conductivity is also calculated using heat current correlation functions. It is shown that a model which treats the lifetime of the single-particle excitation due to lattice interactions as constant yields results in agreement with observed thermal conductivities. (auth)

18361 π^--p INTERACTIONS AT 1.3 Bev. W. D. Shephard and W. D. Walker (Univ. of Wisconsin, Madison). Phys. Rev., 126: 278-95(Apr. 1, 1962).

A study is made of the interactions of 1.3-Bev π^- mesons in a propane bubble chamber. Out of 1401 two-prong interactions measured and analyzed, 587 are classified as hydrogen interactions. Techniques used in scanning, measurement, and analysis, and the uncertainties involved in these techniques are discussed with special reference to the problem of carbon contaminination. Corrections to the data are calculated. Best values for cross sections at this energy are: $\sigma_{el} = 10.5 \pm 0.8$ mb, $\sigma_{\pi^-p\to\pi^0n} = 9.2 \pm 1.4$ mb, $\sigma_{\pi^-p\to\pi^0p} = 6.2 \pm 0.9$ mb, $\sigma_{neutral} = 5.2 \pm 0.2$ mb, and $\sigma_{\pi^-p\to\pi^+p} = 1.0^{+0.5}_{-0.3}$ mb, normalized to $\sigma_{total} = 34.7 \pm 1.2$ mb. A study of

$\pi^- + n \rightarrow \pi^- + \pi^- + p$ events in carbon is used to provide evidence on carbon contamination in single pion production. The data on single pion production processes are compared in detail with the predictions of the statistical model, the isobar model, and pion–pion interaction theory. The extended isobar model given qualitative agreement with some features of the c.m. momentum spectra, but quantitative agreement is poor. Evidence is found for a resonance in $\sigma_{\pi\pi}(\omega)$ between 700 and 800 Mev total energy for the dipion system. The data are consistent with a resonance in the $T = J = 1$ $\pi - \pi$ state. A rise in the $\pi - \pi$ cross section at low energies appears to occur. Differences in results for (π^-,π^+,n) and (π^-,π^0,p) events are considered. Evidence for final-state pion-nucleon interactions in conjunction with pion-pion interactions is presented. (auth)

18362 ELECTROMAGNETIC PRODUCTION OF CHARGED VECTOR MESONS. Sidney A. Bludman and James A. Young (Univ. of California, Berkeley). Phys. Rev., 126: 303-9(Apr. 1, 1962). (UCRL-9837)

The Coulomb scattering, Compton scattering, bremsstrahlung, and pair production of charged particles of spin one is investigated, in comparison with that of spin zero and one-half particles. The singular role of the longitudinal meson degree of freedom in high-energy processes is emphasized. The pair production of charged vector mesons of unit and zero magnetic moment is calculated in Wiezsäcker-Williams approximation and compared with the cross section for their production by neutrinos. (auth)

18363 MEASUREMENT OF LINEAR PHOTON POLARIZATION BY PAIR PRODUCTION. L. C. Maximon and Haakon Olsen (National Bureau of Standards, Washington, D. C. and Norges Tekniske Høgskole, Trondheim, Norway). Phys. Rev., 126: 310-19(Apr. 1, 1962).

The cross section for production of electron–positron pairs by linearly polarized high energy photons is calculated for the case in which the pair particles and the photon are nearly coplanar. The cross section is integrated over the polar angles θ_1 and θ_2 between the momenta of the positron and the photon, and the momenta of the electron and the photon, respectively, and over a small range $2\Delta\phi$ of the azimuthal angle $\varphi = \varphi_1 - \varphi_2$ between the pair particles about $\varphi = \pi$. The asymmetry ratio, defined as the ratio of the number of pairs emitted parallel to the photon polarization plane to the number of pairs emitted perpendicular to this plane, is plotted as a function of $\Delta\phi$ for the cases of no screening and complete screening. It is shown that for very small $\Delta\phi$ the cross section is a very rapidly varying function of $\Delta\phi$, such that the pairs emitted within the angular region $2\Delta\phi$ are predominantly perpendicular to the polarization plane for $\Delta\phi < \Delta\phi_0[\Delta\phi_0 = 1.23(Z^{1/3}/111)$ for complete screening, for example] and predominantly parallel to this plane for $\Delta\phi > \Delta\phi_0$. A discussion and comparison of several possible experimental methods for measuring the asymmetry ratio is given, viz., observing nearly coplanar pairs, observing only one of the pair particles and, lastly, observing all pairs except those which are emergent over a narrow angular range $2\Delta\phi$. The asymmetry ratio for the last method is also calculated and curves of the asymmetry ratio, as a function of the angular range $2\Delta\phi$ over which pairs are rejected, are given. This last method gives higher asymmetry ratios than do the two others. Coulomb corrections are included. (auth)

18364 Σ^0 LIFETIME AND ASSOCIATED PHOTOPRODUCTION POLES. Richard H. Capps (Northwestern Univ., Evanston, Ill.). Phys. Rev., 126: 324-8(Apr. 1, 1962).

The Born-approximation calculations for the differential cross sections for photoproduction of $K^+ - \Lambda$ and $K^+ - \Sigma^0$ pairs from hydrogen are generalized to include the effect of the $\Sigma - \Lambda$ mass difference and the possibility of odd $\Sigma - \Lambda$ parity. The residues of the poles in the unphysical regions of the center-of-mass production angle are computed. It is shown that if the laboratory photon energy is greater than about 2 Bev, information may be obtained about the Σ^0 lifetime and the anomalous moment of the produced hyperon by extrapolating the experimentally measured differential cross section in the backward direction of the K-production angle. (auth)

18365 PRODUCTION OF PION PAIRS BY A PHOTON IN THE COULOMB FIELD OF A NUCLEUS. Yongduk Kim (Univ. of California, Berkeley). Phys. Rev., 126: 345-52 (Apr. 1, 1962). (UCRL-9734)

The possibility is studied of measuring the π-π interaction by means of electromagnetic pion-pair production in the Coulomb field of a nucleus. The Mandelstam representation is set up for the process γ(virtual) + $\gamma \rightarrow \pi + \pi$, and partial-wave dispersion relations are derived. Solutions for the ensuing integral equations are obtained within the approximation of retaining only the one-pion exchange contribution to the unphysical cut. It is sufficient to consider only the π-π S-wave interaction, for which a current estimate with a virtual $I = 0$ state near threshold is utilized. Results indicate that the effects of the π-π final-state interaction on the Coulomb process may be observed in the presence of nuclear pair production, provided that the momentum transfers to the nucleus are small (smaller than ~70 Mev/c in the illustrative case of an incident photon of 6 Bev). (auth)

18366 WOOLLY CUSPS. M. Nauenberg (Columbia Univ., New York) and A. Pais. Phys. Rev., 126: 360-4 (Apr. 1, 1962).

A study is made of the elastic scattering $1 + 2 \rightarrow 1 + 2$ in the energy region where the inelastic process $1 + 2 \rightarrow 3 + 4$ sets in, for the case that particle 3 is unstable. By "woolly cusp" is meant the phenomenon that corresponds to the sharp cusp in the stable case. The procedure followed is to consider the inelastic channel to be of the three-body type, where the three-body states are parametrized by a Breit-Wigner formula around a mean mass m^* of particle 3. The connection between a woolly and a sharp cusp is made evident. The problem is studied in terms of a two-channel S-wave K matrix. In the two-channel approximation the woolly cusp necessarily shows a decrease in the elastic cross section σ above a characteristic energy. As a function of energy, σ must either show a maximum or an inflection point. In either case, the energy at which this happens may lie above or below the inelastic threshold for the fictitious case that particle 3 has a sharp mass m^*. The sign and magnitude of the elastic scattering phase shift at this "m^* point" approximately determines which case is actually realized. (auth)

18367 POSSIBLE NEUTRINOLESS DECAY MODES OF THE MUON. J. Dreitlein and H. Primakoff (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 126: 375-8(Apr. 1, 1962).

An phenomenological theory is given of possible "two-photon" neutrinoless decay processes: $\mu^+ \rightarrow e^+ + \gamma + \gamma$; $\mu^- + \text{nucleus} \rightarrow \mu^- + \gamma$ (virtual Coulomb) + nucleus $\rightarrow e^- + \gamma$ + nucleus; and $\mu^- + \text{nucleus} \rightarrow \mu^- + \gamma$ (virtual Coulomb) + γ (virtual Coulomb) + nucleus $\rightarrow e^- +$ nucleus. It is found that the decay, $\mu^- + \text{nucleus} \rightarrow e^- + \gamma +$ nucleus, is the most probable of the three under consideration. (auth)

18368 INTERPRETATION OF RANGE MEASUREMENTS FOR KILOVOLT ELECTRONS IN SOLIDS.

II. Kanter and E. J. Sternglass (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 126: 620-6(Apr. 15, 1962).

The maximum range of electrons, as distinguished from the extrapolated or practical range, is measured in Al, Ni, Ag, and Au for electron energies between 1.0 and 10.0 kev. The technique utilized involves the detection of the onset of penetration through freely supported evaporated films by observation of the current collected in a 2π geometry. The range defined in this manner may be compared with the predictions of stopping theory, with little influence of scattering processes. The results show no significant Z dependence of the exponent in the range-energy relation, in agreement with results at higher energies. Some indications exist for an increasing value of the absolute range with increasing Z when expressed in mg/cm^2, in accordance with the theoretically predicted decrease in stopping power for heavier elements. The results are compared with measurements using the onset and decline of luminosity in a phosphor layer to define the range, which leads to a strong Z dependence of the range-energy relation in the opposite sense to that observed by absorption techniques. It is shown than the differences in results may be traced to the nature of the detecting technique. The luminescence detector is sensitive to the total energy carried by the penetrating electrons in excess of a certain critical value rather than to their number. (auth)

18369 SINGLE NEUTRAL PION PRODUCTION BY PIONS AT 1100 Mev. V. P. Kenney, W. D. Shephard, and C. D. Gall (Univ. of Kentucky, Lexington). Phys. Rev., 126: 736-47(Apr. 15, 1962).

Well-identified events of the type $\pi^- + p \rightarrow p + \pi^- + \pi^0$ were obtained by requiring, in addition to satisfaction of kinematic criteria, that the production of the neutral pion be verified by observation of either a γ-ray conversion electron pair or a Dalitz-decay pair associated with the interaction. In a scan of 10^5 Bevatron photographs 70 acceptable events were found. The kinematic behavior of the selected events did not agree with the predictions of the isobar model, but was consistent with the assumption that the events were initiated by a strong pion-pion interaction, with subsequent rescattering of pions by the nucleon. There was some indication that two T = 1 dipion states with total energies of 565 and 750 Mev were involved in the interactions. (auth)

18370 MULTIPLE MESON PRODUCTION IN PROTON-PROTON COLLISIONS AT 2.85 Bev. E. L. Hart, R. I. Louttit, D. Luers, T. W. Morris, W. J. Willis, and S. S. Yamanoto (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 126: 747-56(Apr. 15, 1962). (BNL-5813)

Measurements are made on 753 four-prong events obtained by exposing a 20-in liquid hydrogen bubble chamber to 2.85-Bev protons. The partial cross sections observed for multiple meson production reactions are: pp +−(p + p → p + p + $\pi^+ + \pi^-$), 2.67 ± 0.13; pn++−, 1.15 ± 0.09; pp +− 0, 0.74 ± 0.07; d ++−, 0.06 ± 0.02; and four or more meson production, 0.04 ± 0.02 mb. Production of two mesons appears to occur mainly in peripheral collisions with relatively little momentum transfer. In cases of three-meson production, however, the protons are typically deflected at large angles and are more strongly degraded in energy. The $\frac{3}{2}, \frac{3}{2}$ pion-nucleon resonance dominates the interaction; there is some indication that one or both of the T = $\frac{1}{2}$, pion-nucleon resonances also play a part. The resonance in a T = 0, three-pion state appears to be present in the pp +− 0 reaction. Results are compared with the predictions of the isobaric nucleon model and the statistical model. The cross section for the reaction $\pi^0 + p \rightarrow \pi^+ + \pi^- + p$ is derived using an expression from the one-pion exchange model. (auth)

18371 I = 2 S-WAVE $\pi-\pi$ SCATTERING LENGTH. Janos Kirz, Joseph Schwartz, and Robert D. Tripp (Univ. of California, Berkeley). Phys. Rev., 126: 763-5(Apr. 15, 1962). (UCRL-9941)

By means of investigation of the reaction $\pi^+p \rightarrow \pi^+\pi^+n$ at 357 Mev, the I = 2 $\pi-\pi$ scattering length is found to be $|a_2| \lesssim 0.15$ pion Compton wavelengths. (auth)

18372 MODEL OF PIONIC HYPERON DECAY. Jugoro Iizuka and Reinhard Oheme (Univ. of Chicago). Phys. Rev., 126: 787-8(Apr. 15, 1962).

Using a phenomenological V + A coupling for the weak vertex $\Lambda \rightarrow N + \pi$, a simple model of the decays $\Sigma \rightarrow N + \pi$ is constructed under the assumption of odd $\Sigma\Lambda$ parity. The model predicts that $\alpha_\theta \approx -\alpha_\Lambda$ and that the decay $\Sigma^- \rightarrow n + \pi^-$ ($\Sigma^+ \rightarrow n + \pi^+$) is essentially pure s-wave (p-wave). (auth)

18373 EFFECTIVE RANGE ANALYSIS OF s-WAVE K^-p REACTIONS. Gordon L. Shaw (Univ. of California, San Diego and La Jolla) and Marc H. Ross. Phys. Rev., 126: 814-23(Apr. 15, 1962).

An effective range analysis of s-wave K^-p reaction data is carried out. Two specific problems are investigated. First, a survey is made of solutions which, in addition to fitting the K^-p threshold data, yield a $\pi\Lambda$ resonance having the characteristics of the Y_1^*. The only acceptable solutions found imply even $K\Sigma N$ parity and do not lead to Y_0^* resonance. Other features of these solutions are discussed, as well as the validity and applicability of the effective range approximation to describe the energy dependence of the $\bar{K}N$ data. Second, using a nonperturbative uncoupled phase procedure, an investigation is made of effective range solutions for the threshold K^-p data which, in the absence of influence of the $\bar{K}N$ channel, would have the pion-hyperon scattering amplitudes predicted by global symmetry of the pion-baryon interaction. The concept of global symmetry is found to be compatible with the K^-p data. The actual πY phases, however, are quite different from the global symmetry uncoupled phases in states coupled to the $\bar{K}N$ s wave, and there are solutions in which the Y_0^* arises as a quasi-bound-state resonance. Going beyond the physical predictions of these surveys, it is concluded that there are almost enough $\bar{K}N$ data above threshold to justify a search for effective range solutions (then predicting whether either Y_1^* or Y_0^* is in the same partial wave as a $\bar{K}N$ s state). Moreover, it is clear that such solutions are quite different from the results of a constant scattering-length analysis of low-energy data. (auth)

18374 PION-NUCLEON PROCESSES ABOVE THE FIRST MAXIMUM ACCORDING TO THE STRONG-COUPLING METHOD. Helmut Jahn (Brandeis Univ., Waltham, Mass.). Phys. Rev., 126: 824-30(Apr. 15, 1962).

A rough estimate of pion production, by pion-nucleon collisions at 300 to 600 Mev in the lab system, is carried out on the basis of the strong-coupling method. This method, explicitly introducing the nucleon isobars, gives as the main contribution the pion production via isobaric excitation. A mechanism for pion productions via isobaric excitation follows without an extra $\pi-\pi$ interaction term, using only the fixed-source theory. The neglect of nucleon recoil in the fixed-source theory is not serious for pion production below 1 Bev. The results for the magnitude and energy dependence of the pion production cross section are within the same order of magnitude as the experimental results. It is also found that the contribution to the isospin-$\frac{3}{2}$ states are about 4 times smaller than those to the isospin-$\frac{1}{2}$

states, which is substantiated by experimental results in the energy range concerned. Thus it is shown that these important properties of the pion production cross section for pions on nucleons can be explained by the strong-coupling approximation of the fixed-source theory without an extra π-π term. (auth)

18375 CORRECTIONS TO THE IMPULSE APPROXIMATION IN SCATTERING FROM DEUTERONS. Allen Everett (Tufts Univ., Medford, Mass.). Phys. Rev., 126: 831-45(Apr. 15, 1962).

The effect of binding and multiple-scattering corrections to the impulse approximation, as well as of corrections due to the presence of off-the-energy-shell matrix elements is discussed for the case of scattering from a deuteron or other two-particle system. Those binding and multiple-scattering corrections that have the form of double scattering are evaluated explicitly for the case of quasi-elastic p-d scattering at 145 Mev, and their inclusion is found to give agreement with the experimental results on the cross section and polarization despite the fact that estimates of the triple-scattering corrections show they are of magnitude comparable to the effects that are included. The double-scattering corrections to the cross section, polarization, and R and A parameters for quasi-elastic n-d scattering at the same energy are also given. The off-the-energy-shell corrections are evaluated numerically, and are found to be too small to be observed because of experimental errors and uncertainty in the calculation of the multiple-scattering corrections. (auth)

18376 BREMSSTRAHLUNG ACCOMPANYING HIGH-ENERGY π MESON-PROTON COLLISIONS. H. Ueberall (Univ. of Michigan, Ann Arbor). Phys. Rev., 126: 861-75 (Apr. 15, 1962).

The radiation from charged π mesons colliding with protons is calculated. This radiation, in the case of high energies and small emission angles, is produced largely externally with respect to the range of the nuclear force, and therefore the process may be calculated with some accuracy in spite of the fact that strong interactions are involved. The results depend on the experimentally determined parameters of elastic pion-proton scattering (i.e., the complex phase shifts). These are obtained from an analysis of elastic scattering data, and are used for a numerical calculation of the bremsstrahlung. (auth)

18377 PRODUCTION AND SPIN OF THE K* RESONANCE. S. W. MacDowell, A. L. L. Videira, and N. Zagury (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Phys. Rev., 126: 878-80(Apr. 15, 1962).

Experimental results on the production of K^* in the reaction $K^- + p \rightarrow \overline{K}^0 + \pi^- + p$ are discussed. If spin 1 is assumed for K^* a satisfactory explanation of the data is obtained using a model in which, in addition to the exchange of a π meson, the effect of the resonance Y_4^* ($m_4 = 1812$ Mev, $T = 0$) is taken into account. This model requires Y_4^* to occur in the $d_{\frac{5}{2}}$ state of the K^-p system. It is predicted that $\langle \cos^2 \theta \rangle = 0.29$ in $K^- + p \rightarrow K^- + \pi^+ + n$. It is suggested that angular correlation measurements at a higher energy might distinguish between $S = 0$ and $S = 1$ for K^*. (auth)

18378 NOTE ON A NUCLEON-NUCLEON POTENTIAL. K. E. Lassila, M. H. Hull, Jr., H. M. Ruppel, F. A. McDonald, and G. Breit (Yale Univ., New Haven). Phys. Rev., 126: 881-2(Apr. 15, 1962).

A nucleon-nucleon potential was used in an approximate representation of phenomenological phase–parameter fits to p-p and n-p scattering data. The potential employs a hard core and is different for singlet-even, singlet-odd, triplet-even, and triplet-odd states. It consists of central, tensor, spin-orbit, and quadratic spin-orbit parts. The latter are indicated by the singlet-even and triplet-even interactions, and are used only for even states. Coefficients in formulas for the potential are tabulated. (auth)

18379 NEUTRON FORM FACTORS AND NUCLEON STRUCTURE. C. de Vries and R. Hofstadter (Stanford Univ., Calif.). Phys. Rev. Letters, 8: 381-5(May 1, 1962).

While nucleon models previously proposed appear satisfactory, the numerical values of parameters require certain changes. Differences are ascribed to more precise and abundant measurements of electron scattering by hydrogen and deuterium, and improved theory. Data are presented in graphical and tabular forms. (L.N.N.)

18380 SOME ANALYTIC PROPERTIES OF THREE-PION DECAY AMPLITUDES. G. Bonnevay (Univ. of Birmingham, Eng.). Proc. Roy. Soc. (London), A266: 68-83(Feb. 27, 1962).

It is shown for all graphs of the strip approximation that the $K \rightarrow 3\pi$ decay amplitude obeys a Mandelstam double-dispersion relation. The double spectral function turns out to be complex and covers the whole physical domain, so that the Cini-Fubini approximation is no longer valid. Essential singularities are found on the border of the physical sheet. Double-dispersion relations in one energy and in the K mass are also derived. (auth)

18381 MUON PAIR CREATION BY A HIGH ENERGY ELECTRON. Takao Yamamoto (Hirosaki Univ., Japan). Progr. Theoret. Phys. (Kyoto), 27: 233-40(Feb. 1962). (In English)

The cross section for muon pair creation by an electron is investigated by the Feynman-Dyson method. Its numerical values are calculated at about 1 Bev. At the angles of emitted muons, $\theta_+ = \theta_- < 45°$, the main contribution to the cross section comes from the Feynman diagrams in which the virtual photon has a time-like four momentum. (auth)

18382 TWO-NUCLEON POTENTIALS FROM DISPERSION RELATIONS. Tomoya Akiba (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 27: 241-61(Feb. 1962). (In English)

Dispersion relations are applied to obtain the two-pion-exchange nuclear potentials including the first order non-static effects. Calculation is made within the approximation in which only the contribution from the single nucleon intermediate state is considered for pion-nucleon scattering, though the S-wave suppression is considered. All the potentials are expressed in a spectral representation. It is shown that this form is suitable to distinguish the effects of low-energy pion exchange from those of high-energy exchange. The former can be reliably estimated; the latter are subjected to a cutoff and substituted by adjustable parameters. The potentials obtained are compared with phenomenological ones in terms of the spectral distributions of exchanged pions. Comparison of the method with the others for potential construction is made in relation to the problem of the coupling type between pions and nucleons. (auth)

18383 THE NATURAL COORDINATE SYSTEM IN MINKOWSKI'S ISOPACE FOR ½-SPIN PARTICLE. Jerzy Lukierski (Univ. of Wrocław, Poland). Progr. Theoret. Phys. (Kyoto), 27: 262-72(Feb. 1962). (In English)

A Lagrangian formalism invariant with respect to the 12-parameter group $C \times C'$, for a quantized ½-spin field, is investigated. The groups C and C' describe two Minkowski's rotation groups. Four orthogonal isovectors in the Minkowski's isospace are introduced: two isovectors are obtained from the Lagrangian, and the third from the

definition of charge conjugation operation. Dirac, Jauch, and Ozaki fields are obtained after special choices of the four basic isovectors. (auth)

18384 FORM FACTOR AND ITS ISOSCALAR PART OF THE NUCLEONS. Shigeo Goto (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 27: 273-82(Feb. 1962). (In English)

A theoretical analysis of the isoscalar part of the nucleon structure is performed by considering the pion-pion resonance. The model in which this resonance is replaced by a boson field, i.e., ρ meson, is adopted. It is shown that from the covariance argument the isoscalar parts of the form factors of the charge and the magnetic moment are related, considering the three-pion state as the scattering state of the pion and the ρ meson. A set of form factors is proposed using this result. The outer part of the charge distribution of the neutron in this set becomes negative, in contrast with proposed sets. Discussions are given on the interpretation of the data. (auth)

18385 GENERALIZED WARD IDENTITIES FOR VECTOR BOSON FIELD. Keiji Kikkawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 27: 283-7(Feb. 1962). (In English)

The generalized Ward identities for vector-meson fields are derived. The identities are common consequences of the partially gauge-invariant field. It is shown that the identities differ from those in quantum electrodynamics, due to the self-interaction of the vector field. (auth)

18386 TWO-NUCLEON POTENTIAL WITH FULL RECOIL. II. TWO-PION-EXCHANGE POTENTIAL. Norio Hoshizaki and Shigeru Machida (Tokyo Univ. and Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 27: 288-314(Feb. 1962). (In English)

Nonstatic two-pion-exchange potential is calculated to the fourth order of the pion-nucleon coupling constant without using the expansion with respect to the inverse of the nucleon mass. The potential is obtained in the momentum space and transformed into the configuration space. Results are compared with the static limit and the first order term in the M^{-1} expansion. The nonstatic one-pion-exchange potential is discussed. (auth)

18387 TWO-NUCLEON POTENTIAL WITH FULL RECOIL. III. DETAILED DISCUSSIONS ON ITS CHARACTERISTIC FEATURES. Shoichiro Otsuki (Nagoya Univ., Japan), Ryozo Tamagaki, and Wataro Watari. Progr. Theoret. Phys. (Kyoto), 27: 315-41(Feb. 1962). (In English)

Characteristic features of the nonstatic one- and two-pion-exchange potentials are discussed and compared with data. Contained are the difference between the ps- and pv-coupling cases, the need for taking account of effect due to the $(3/2, 3/2)$-resonance, and the weak tail of the spin-orbit coupling potential. Possible indications that the pion-nucleon interaction may be of the ps- and the pv-type are discussed. (auth)

18388 VARIATIONAL STUDY OF THE GROUND STATE OF A BOSE-EINSTEIN FLUID. Kazuo Hiroike (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto), 27: 342-60(Feb. 1962). (In English)

Under the assumption that the gound-state wave function is expressed as a product of pair functions, the expectation value of the ground-state energy is rigorously expressed in terms of the pair distribution function. An integro-differential equation is derived for the pair distribution function from the variational principle that the expectation value of the energy is minimum. It is pointed out that the expression for the energy and the integro-differential equation become identical with those derived by Abe if the hyper-netted chain (HNC) approximation is introduced. It is proved that the HNC approximation is compatible with the virial theorem. The nature of the formulas is investigated by application to cases investigated by other theories. It is suggested that the present theory may, in general, predict the phonon-like excitations. (auth)

18389 CONTINUATION OF S-MATRIX INTO SECOND RIEMANN SHEET. Takesi Ogimoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 396-403(Feb. 1962). (In English)

In the framework of relativistic dispersion theory, it is shown that the S matrix continued into the second Riemann sheet is just the inverse of the one on the first Riemann sheet. This formula is used for deriving a dispersion-like relation between the real and imaginary parts of the scattering phase shift and the product expansion for the S matrix. These results are generalizations of van Kampen's formulas in the theory of nonrelativistic potential scattering to those in the relativistic field theory. The Castillejo-Dalitz-Dyson ambiguity is discussed on the basis of the S matrix. Relations connecting the sum of the oscillator strengths with scattering lengths are derived in generalized forms. (auth)

18390 ON THE LANDAU THEORY OF FERMI FLUIDS. A. UNIFORM AND NON-UNIFORM EQUILIBRIUM SYSTEMS. Tohru Morita (Shizuoka Univ., Japan). Progr. Theoret. Phys. (Kyoto), 27: 423-5(Feb. 1962). (In English)

The formal structure of the Landau theory for uniform and nonuniform equilibrium Fermi fluids is presented using techniques given in a general theory of classical fluids (T. Morita and K. Hiroike, Progr. Theoret. Phys. (Kyoto), 25: 537(1961)). The uniform case is presented, and results are generalized to the nonuniform case. (L.N.N.)

18391 ON THE LANDAU THEORY OF FERMI FLUIDS. B. MACROSCOPIC KINETIC EQUATION. Tohru Morita (Shizuoka Univ., Japan). Progr. Theoret. Phys. (Kyoto), 27: 425-7(Feb. 1962). (In English)

It is shown that the kinetic equation, in which the particles drift under the action of the external field and by interactions with other particles, can be written such that the particles are considered to be accelerated by a macroscopic field rather than individual interactions. Quantum and classical fluids are considered; the quantum case is derived in connection with the Landau theory of Fermi fluids. (L.N.N.)

18392 THEORY OF COLLECTIVE MOTION OF PARTICLES. Hazime Mori (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 427-9(Feb. 1962). (In English)

A method for finding the frequency spectrum and the damping constant of the collective motion of interacting particles is presented. The method corresponds to a generalization of the quantum theories of collective motion at finite temperatures. (L.N.N.)

18393 NOTE ON THE DISPERSION RELATIONS IN NUCLEON-NUCLEON SCATTERING AND RESONANCES IN MANY-PION SYSTEM. Yasuo Hara (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 27: 429-30(Feb. 1962). (In English)

Using dispersion relations as sum rules, a resonance in either the neutral vector or the neutral pseudoscalar boson state, or in both states of the many-pion system was found (Y. Hara, Progr. Theoret. Phys. (Kyoto), 26: 627 (1961)). Agreement of theory with experiment is improved by identifying the resonance with one found in p-$\bar{p}$ annihilation, with mass at 787 Mev, $T = 0$, and $J = 1^-$. Results of calculations for unpolarized p-p forward scattering are presented in graphical form. (L.N.N.)

18394 ABOUT THE RADIATION OF RELATIVISTIC ELECTRON, MOVING ON THE SPIRAL IN MAGNETIC FIELD. I. M. Ternov and A. S. Stepanov. Vestnik Moskov. Univ., Ser. III, No. 5, 83-9 (Sept.-Oct. 1961). (In Russian)

Quantum theory methods are used in resolving the problem of emission by electrons in motion in a constant homogeneous magnetic field. The angular distribution of polarized radiation, considering electron spin, is derived with the assumption that the component of the pulse along the field is not zero. (tr-auth)

18395 TO THE QUESTION OF DISPERSION OF DIAMETRICAL POLARIZED PARTICLES WITH SPIN EQUAL ONE. Yu. A. Popov. Vestnik Moskov. Univ., Ser. III, No. 5, 90-6 (Sept.-Oct. 1961). (In Russian)

The elastic scattering of oppositely polarized particles with spin-1 in V, S, Ar, P, and T interaction is analyzed. Differential cross sections and polarization vectors are calculated. (tr-auth)

18396 TOTAL CROSS SECTIONS FOR π^--MESON–PROTON INTERACTION AT HIGH ENERGIES. A. S. Vovenko, L. B. Golovanov, B. A. Kulakov, A. L. Lyubimov, Yu. A. Matulenko, I. A. Savin, and E. V. Smirnov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 715-20 (Mar. 1962). (In Russian)

The total cross sections for π^--proton interaction are measured for momenta of 3.4, 3.9, 4.9, 7.0, and 9.2 Bev/c. The results of the measurements indicate a slow decrease of the cross section with increasing energy. (auth)

18397 CONCERNING THE GRAVITATIONAL MASSES OF K^0- AND $\overline{K}^0$-MESONS. E. O. Okonov, M. I. Podgoretskii, and O. K. Chrustalev (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 770-1 (Mar. 1962). (In Russian)

The possibility is discussed of an experimental investigation of the gravitational properties of the $\overline{K}^0$. (auth)

18398 SPECTRAL REPRESENTATIONS OF MATRIX ELEMENTS. R. V. Tevikyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 779-82 (Mar. 1962). (In Russian)

Spectral representations are obtained for the matrix elements of the product of n scalar Heisenberg operators. (auth)

18399 ON THE POSITION OF SINGULARITIES OF FEYNMAN DIAGRAMS. A. Z. Patashinskii (Inst. of Thermal Physics, Siberian Branch of the USSR Academy of Sciences). Zhur. Eksptl'. i Teoret. Fiz., 42: 812-19 (Mar. 1962). (In Russian)

The denominator of the integrand of the parametric representation of the Feynman integrals is studied. The part of the quadratic form that thus appears and depends on the external momenta is singled out. The results are used to determine the position of singular curves. The asymptote equations of the singular curves are written down for four-tails. It is shown that the second asymptote is not encountered in all the diagrams and that it is located at larger values of the finite invariant than the usual asymptote of the singular curve for variation of internal masses of the diagram. (auth)

18400 ELASTIC SCATTERING OF HIGH ENERGY PIONS AND NUCLEONS. D. I. Blokhintsev (Joint Inst. for Nuclear Research, Dubna USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 880-1 (Mar. 1962). (In Russian)

It is shown that under very general assumptions the cross section for large angle elastic scattering of strongly interacting particles should vary as the reciprocal of the incident particle energy in the laboratory coordinate system. (auth)

18401 COLLISION INTEGRAL FOR CHARGED PARTICLES IN A MAGNETIC FIELD. V. M. Eleonskii, P. S. Zyryanov, and V. P. Silin (Inst. of Physics of Metals, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 896-904 (Mar. 1962). (In Russian)

An expression is deduced for the collision integral of particles interacting according to Coulomb's law. Screening caused by polarization of the medium is taken into account by means of a complex dielectric permeability tensor, which takes into account the time as well as the space dispersion. (auth)

18402 MEASUREMENTS OF TOTAL $\pi^- - p$ REACTION CROSS SECTION FOR 340-Mev π^- MESONS. T. D. Blokhintseva, V. G. Grebinnik, V. A. Zhukov, G. Libman, L. L. Nemenov, G. I. Selivanov, and Jung-fang Yuan (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 912-13 (Mar. 1962). (In Russian)

The reactions $\pi^- + p \rightarrow \pi^- + \pi^+ + n$, $\pi^- + p \rightarrow \pi^- + \pi^0 + p$, and $\pi^- + p \rightarrow \pi^- + \gamma + p$ at a π^- energy of 340 ± 15 Mev were measured with a 25-cm liquid-hydrogen chamber placed in a magnetic field of 12000 gauss. The total cross sections were found to be $\sigma_1 = 1.24 \pm 0.14$ mb, $\sigma_2 = 0.13^{+0.6}_{-0.6}$ mb, $\sigma_3 = 0.09^{+0.93}_{-0.96}$ mb, respectively. (R.V.J.)

18403 SEARCH FOR D^+ MESON. B. A. Nikol'skii, L. V. Surkova, A. A. Varfolomeev, and M. M. Sulkovskaya. Zhur. Eksptl'. i Teoret. Fiz., 42: 915-16 (Mar. 1962). (In Russian)

An attempt was made to find the D^+ meson in the vicinity of its origin. It was found that the probability of producing slow D^+ particles, decaying into K^+ by 9-Mev proton emission, is less than $1/_{500}$ the probability of slow K^+ production. For comparison, the number of slow K^+ mesons is about $1/_{300}$ the number of π^+ mesons stopping in the emulsion chamber. (R.V.J)

Neutron Physics

18404 (UNC-5006) A DESCRIPTION OF AN IBM-7090 MONTE CARLO PROGRAM (UNC-90-6) FOR THE SOLUTION OF THE TIME DEPENDENT NEUTRON TRANSPORT PROBLEM IN AN ATMOSPHERE WITH DENSITY DEPENDENT ON HEIGHT. C. Marotta and W. Guber (United Nuclear Corp. Development Div., White Plains, N. Y.). Apr. 15, 1962. Contract DA-49-186-ORD-1012. 62p.

An IBM-7090 Monte Carlo program is described that is designed for studies of the transport of neutrons from a point monoenergetic source in an atmosphere with density dependent on height up to 700 kilometers. The earth is treated as an absorbing surface. The neutron flux is calculated at specified detector regions as a function of time and energy. An importance sampling technique is incorporated in the program to improve statistics at detectors many mean free paths from the source. A Final Edit Program is also described that can be used to superpose, with specified weighting, the results for various monoenergetic sources. (auth)

18405 DIFFUSION PARAMETERS OF THERMAL NEUTRONS IN DIPHENYL. R. Bayer, J. Červená, W. Schaeferlingová (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Czechoslov. J. Phys., 12: 107-10 (1962). (In English)

The diffusion length, diffusion coefficient, and mean life

time of thermal neutrons in solid diphenyl were measured by the impulse method at 20°C. (auth)

18406 SOME APPLICATIONS OF INVARIANT IMBEDDING TO PROBLEMS OF NEUTRON TRANSPORT. I. MONOENERGETIC NEUTRONS DIFFUSING IN ONE SPACE DIMENSION. Ottis W. Rechard (Washington State Univ., Seattle). J. Math. Anal. and Appls., 4: 85-101(Feb. 1962).

Neutron diffusion in a homogeneous slab of material that is unbounded in two dimensions is studied. Processes that the neutrons can undergo include fission, capture, and elastic and inelastic scattering, and all these processes are assumed to be isotropic. The neutron sources are assumed to be distributed in a plane parallel to the slab faces, and the source plane may be either external or internal to the slab. Attention is given to the number of collisions, the number of transmitted and returning neutrons, the number of j^{th} collisions, and other parameters involved in the diffusion. (T.F.H.)

18407 THE SYMMETRIZATION OF MATRICES BY DIAGONAL MATRICES. Seymour V. Parter (Cornell Univ., Ithaca, N. Y.) and J. W. T. Youngs. J. Math. Anal. and Appls., 4: 102-10(Feb. 1962).

In multigroup transport theory the nonnegative $n \times n$ matrix $C = (c_{ij})$ is encountered, in which the c_{ij} are transfer coefficients. The weighted probability that a particle in group j will transfer into group i is given by c_{ij}. Considering the condition on C that "there exists a positive diagonal matrix (D) such that DCD^{-1} is a nonnegative symmetric matrix," the necessary and sufficient conditions for the existence of D are found. (T.F.H.)

18408 ANALYSIS OF A PROBLEM OF NEUTRON TRANSPORT IN A CHANGING MEDIUM. G. Milton Wing (Sandia Corp., Albuquerque, N. Mex.). J. Math. and Mech., 11: No. 1, 21-34(Jan. 1962).

Neutron transport in a rod having a cross section that varies with time and position is studied. It is assumed that two particles appear isotropically from each interaction. It is shown that the equation for the general case reduces to that for the neutron flux from a fixed rod of constant cross section. (L.N.N.)

18409 DIFFUSION APPROXIMATION AND VARIATIONAL EXPRESSION FOR THE THERMAL NEUTRON DISTRIBUTION IN SPACE AND ENERGY. Akinao Shimizu (Nippon Atomic Industry Group Co. Ltd., [Japan]). Nippon Genshiryoku Gakkaishi, 4: 161-6(Mar. 1962). (In English)

The diffusion approximation for the motion of neutrons which move in the energy space as well as in the ordinary space is derived from the diffusion approximation for the motion of mono-energetic neutrons. Under this approximation, the variational expression for the space-energy distribution of thermal neutrons is derived. The functional in this expression becomes minimum for the actual distribution. The derived variational method is applied to the problem of the thermal neutron spectrum in a heterogeneous lattice. (auth)

18410 A NEW CALCULATION OF RESONANCE INTEGRALS. L. W. Nordheim (General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng., 12: 457-63 (Apr. 1962). (GA-2734)

A method for the calculation of resonance integrals for both homogeneous and heterogeneous assemblies was developed and programmed for the IBM-7090. It consists of a direct numerical solution of the integral equation for the average flux in the absorber, and obviates the necessity of choosing between the narrow and wide resonance approximations. Cross sections are calculated, inclusive of Doppler broadening, interference scattering, and the $E^{-1/2}$ factor in the absorption cross section. The unresolved resonances are calculated in the narrow resonance approximation under consideration of the Porter-Thomas distribution of neutron widths. Available options include choice of geometry—spherical, cylindrical, slab, and homogeneous; Dancoff correction for absorbers of arbitrary transparency; and integral treatment of admixed scatterers. The only input data required are the resonance parameters and specifications of temperature, composition, and geometry. Everything else is handled automatically. The program calculates directly the cases of interest without requiring any additional data handling. Resonance integrals were computed for uranium and thorium metal and UO_2 and ThO_2 rods of various diameters and different temperatures. Quantitative agreement with the best available measurements is reached for U^{238}, with respect to the absolute values of the resonance integrals, as well as with respect to their temperature dependence. The integral treatment of the oxygen in UO_2 gives a noticeable correction to the resonance integral for thick absorber rods. For Th^{232}, the agreement is not quite so perfect. The differences can be traced to inconsistencies in the available cross section data. (auth)

18411 THE SLOWING DOWN OF NEUTRONS AS A STOCHASTIC PROCESS. Zbigniew Weiss (Inst. of Nuclear Research, Warsaw). Nuclear Sci. and Eng., 12: 464-8(Apr. 1962).

The solution of the neutron slowing down equation in an infinite, homogeneous moderator (with nuclei of mass M) was obtained by means of direct summation of transition probabilities between the initial and final energy states. It was possible to obtain an exact formula for the distribution of neutrons in lethargy space after N collisions with moderator nuclei. The asymptotic expansion of the results for large and for very large N is in agreement with the Dancoff's formulas. The accuracy of the asymptotic expansion was estimated. (auth)

18412 THE EQUIPOISE METHOD—A SIMPLE PROCEDURE FOR GROUP-DIFFUSION CALCULATIONS IN TWO AND THREE DIMENSIONS. Melvin Tobias and T. B. Fowler (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 12: 513-18(Apr. 1962).

An extremely simple iterative procedure is described for performing group-diffusion calculations in two and three dimensions. No proofs were found to guarantee its convergence, but successful experience with a wide variety of problems shows the method to be rapid and reliable. Three large computer programs were devised embodying the principle: EQUIPOISE-3, TWENTY GRAND, and WHIRLAWAY. The first two are two-dimensional programs, while the third is three-dimensional. If desired, the programs can be used to compute adjoint fluxes and those integrals necessary for perturbation calculations automatically. Possible further applications of the method are suggested. (auth)

18413 TIME DEPENDENT, SPACE INDEPENDENT NEUTRON THERMALIZATION. Juan U. Koppel (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 532-41(Apr. 1962). (BNL-5647)

The time dependent thermalization following a burst of fast neutrons is analyzed in the space independent case. The spectrum is decomposed in an asymptotic and a transient part, and the latter is expanded in a series of Laguerre polynomials. The argument of the polynomials is proportional to the time after the burst and the coeffi-

cients of the expansion are linear combinations of the transient time moments. (auth)

18414 ALBEDO LOGIC FOR S_n TRANSPORT ANALYSIS. Bernard H. Duane (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng., 12: 542-4(Apr. 1962). (HW-SA-2282)

Precise surface-albedo logic was formulated for the S_n transport analysis by superposition of linearly independent transport fields generated by a chain-compounded nest of three-pass radial-angular integrations. (auth)

18415 GROUP AVERAGING OF DIFFUSION COEFFICIENTS. P. F. Zweifel and G. L. Bali (Atomic Power Development Associates Inc., Detroit). Nuclear Sci. and Eng., 12: 545-6(Apr. 1962).

Two alternate definitions of group averaged diffusion coefficients given in terms of transport mean free paths are equated with upper and lower limits. Thus, the diffusion of the neutron flux in a reactor may be calculated for practical applications whereby in the past the flux could only be correctly calculated for flux separable in space and energy. With the limits it is possible to form a group cross-section library of average transport mean free paths for use in various calculations. (N.W.R.)

18416 RECURSION METHOD FOR CALCULATING THE SPATIAL DISTRIBUTION OF RESONANCE ABSORPTIONS. Harvey J. Amster (Univ. of California, Berkeley). Nuclear Sci. and Eng., 12: 546-7(Apr. 1962).

The spatial distribution of neutrons absorbed in their first collision within a slab which has a single level Breit-Wigner resonance absorption cross section and a constant scattering cross section is calculated. The angular and energy distribution of neutrons is known at the slab surface. (N.W.R.)

18417 TREATMENT OF ANNULAR VOIDS IN DIFFUSION THEORY. E. Garelis (General Electric Co., Pleasanton, Calif.). Nuclear Sci. and Eng., 12: 547-8(Apr. 1962).

The usual one-dimensional multigroup diffusion codes are used to calculate configurations with annular void regions by assigning a fictitious diffusion coefficient to the void region. The method is suitable for both infinite cylinders and spheres. Basically, the method is to calculate a diffusion coefficient for the void region which preserves the annular void boundary conditions consistent with the neutron streaming problem in the P-1 approximation. (N.W.R.)

18418 SCATTERING OF SLOW NEUTRONS BY SOLID AND LIQUID TERPHENYLS. Robert M. Brugger (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 126: 29-39(Apr. 1, 1962).

The partial differential cross sections for scattering of slow neutrons by solid and liquid terphenyls are presented in scattering law form. The data show that the difference between the scattering from the liquid and the solid is principally of magnitude and not shape. No effects due to the ortho-, meta-, or para-chemical binding are evident. Resonances attributed to transitions between vibrational states in the molecule are seen in the liquid data but not in the solid data. Fourier inversion of the scattering-law data show that the space-time self-correlation function $G_s(\bar{r},t)$ for these materials is not Gaussian. The scattering curves may be grouped into classes of polycrystalline solids, liquid-amorphous solids, and gases. The total cross sections for the terphenyls for 0.0251-ev neutrons are also measured. (auth)

18419 SCATTERING OF SMALL WAVELENGTH NEUTRONS BY A GAS OF HARD SPHERES. G. H. A. Cole (Chapman and Co. Ltd., Durham, Eng.). Phys. Rev., 126: 383-8(Apr. 15, 1962).

The theory of classical fluids, using the Born-Green-Yvon equation and a modified form of the superposition approximation involving powers of the particle number density n, is used to investigate the total neutron elastic scattering cross section for high energy neutrons and heavy nuclei regarded as hard-sphere particles, in the low density limit where a number density expansion is valid. It is found that up to the fourth power of the density, $\sigma_{tot} = 1 - (\lambda^2/2\pi)\,(n - 0.458n^2 + 0.273n^3 - 0.213n^4)$, in the low density limit. (auth)

18420 STUDIES OF THE OPTICS OF NEUTRONS. I. MEASUREMENT OF THE NEUTRON–PROTON COHERENT SCATTERING AMPLITUDE BY MIRROR REFLECTION. W. C. Dickinson, L. Passell, and O. Halpern (Univ. of California, Livermore). Phys. Rev., 126: 632-42 (Apr. 15, 1962). (UCRL-6616)

Measurements were made of the ratio $(a_C/|a_H|)$ of the carbon to the hydrogen coherent neutron scattering amplitudes, using liquid hydrocarbon mirrors with various ratios of hydrogen to carbon atoms. In two of these measurements the reflected neutron intensity from different liquids was compared for a fixed angle of reflection. In two other measurements the angles were determined for which the same reflected intensity was obtained. The ratio of the nuclear amplitudes was found to be 1.775 ± 0.004. Combining this value with the carbon nuclear scattering amplitude, $a_C = (6.64 \pm 0.02) \times 10^{-13}$ cm, the proton scattering amplitude was found to be $a_H = (-3.74 \pm 0.02) \times 10^{-13}$ cm. (auth)

18421 PILE NEUTRON RESEARCH IN PHYSICS. Proceedings of the Symposium on Pile Neutron Research in Physics, held in Vienna, 17-21 October 1960. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1962. 668p. (STI/PUB/36). $12.00(IAEA).

Fifty-six papers are included; separate abstracts have been prepared for 47. Seven papers were previously abstracted in NSA. The papers not abstracted separately are concerned with neutron physics research in underdeveloped countries. Of the 47 papers abstracted separately, 37 are in English, 3 in French, and 7 in Russian. (T.F.H.)

18422 REVIEW OF PILE NEUTRON RESEARCH AND PHYSICS AT THE OAK RIDGE NATIONAL LABORATORY. A. H. Snell (Oak Ridge National Lab., Tenn.). p.49-62 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

A description is given of research relating to neutron diffraction, time-of-flight neutron spectrometry, special measurements using induced radioactivity, and experiments on the fission process, including fission of aligned nuclei. (auth)

18423 NEUTRON RESEARCH WITH THE FRM REACTOR. H. Maier-Leibnitz (Technische Hochschule, Munich). p.63-82 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The FRM Reactor is described, which is devoted almost entirely to basic research. (auth)

18424 THE MTR NUCLEAR PHYSICS PROGRAMME. J. E. Evans, R. G. Fluharty, and M. S. Moore (Phillips Petroleum Co., Idaho Falls, Idaho). p.93-115 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Several beam and irradiation facilities of the Materials Testing Reactor (MTR) are used in nuclear physics research. Problems are selected and techniques are devel-

oped to make effective use of the MTR's high fluxes. Cross section measurements of isotopes important to breeding, fuel production, and recycle reactors are carried out. Since many of the isotopes in the transthorium and fission-product regions are radioactive, the MTR fast chopper is equipped with an automatic radioactive-sample changer and associated handling facilities. These cross section measurements show how nuclear parameters vary with (N-Z)/A. Simultaneous fission and total cross section measurements on U^{233} reveal two groups of levels. Measurements on Pu^{241}, which has the same spin and parity as U^{233}, show similar groups. Further investigations of this structure involve radiochemical determinations of peak-to-valley mass yields of fission products for different resonances, and direct measurements of eta on a crystal spectrometer. Nuclear chemistry studies make use of the MTR's high fluxes to determine nuclear characteristics of isotopes important to reactors, such as first- and second-order thermal-capture cross sections, resonance integrals, alphas (capture-to-fission ratio) for well-thermalized fluxes, and isomeric states and other levels involved in decay. The production of gram samples of rare and radioactive isotopes is described. Solid-state physics studies of basic neutron interaction mechanisms with atomic and molecular states are reported. These studies provide a basis for understanding the assumptions of reactor theory, and a tool for the study of molecular energy states. A phased-chopper velocity selector is used for measuring energy and angular distribution of low-energy neutrons (<0.5 ev) scattered from various materials, and a cold-neutron facility is used to measure inelastic scattering at a fixed angle and to measure the distributions of vibrational frequencies in single crystals of materials. (auth)

18425 REVIEW OF PILE NEUTRON RESEARCH IN PHYSICS AT THE JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. A. Sugimoto and K. Kakihara (Japan Atomic Energy Research Inst., Tokyo). p.117-21 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The performance testing of a crystal neutron spectrometer and the development of a local-signal-type pile oscillator, which are designed and built for the measurement of thermal neutron absorption cross sections, are described. Using a LiF single crystal with the spectrometer, the full width at the half-maximum intensity is 24′ for JRR-1 pile neutrons, and the sensitivity of the pile oscillator is 0.5×10^{-3} cm^2. Measurements on the energy spectrum and flux distribution of the JRR-1 pile neutrons are reported. These experiments are carried out by integration methods such as threshold reactions of Al^{27}, Ni^{58}, etc.; nuclear emulsion; and semiconductor detection. A neutron spectrometer is used for the measurement of fine spectra. The absolute value of flux intensity is obtained by the beta-gamma coincidence method and the measurement of neutron-induced activity in a 4 π gas flow-counter, and the measured maximum thermal neutron flux is $1.2 \times 10^{12}/cm^2$ sec. (auth)

18426 PILE NEUTRON RESEARCH PROGRAMMES AT THE CENTRO NUCLEARE DELLA CASACCIA, ROME. E. Clementel, M. Giannini, M. Marseguerra, A. Paoletti, G. Pauli, D. Prosperi, and S. Sciuti (Centro di Studi Nucleari della Casaccia, Rome). p.123-7 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The experimental facilities available with the Triga Mark II reactor are described and the experimental research in progress or under study is discussed. (auth)

18427 REVIEW OF PILE NEUTRON PHYSICS AT THE AAEC RESEARCH ESTABLISHMENT. K. P. Nicholson and J. L. Symonds (Australian Atomic Energy Commission, Lucas Heights, New South Wales). p.129-31 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The HIFAR reactor (DIDO type; 10 Mw) went critical in 1958. Neutron flux and spectrum measurements are carried out on this reactor. Effort is concentrated on improving the neutron-energy spectrum measurements in HIFAR together with the development of apparatus for neutron cross section and spectrum measurements. Neutron diffraction studies include an estimate of the energy distribution of neutrons emerging from a horizontal collimator. The transmission of subthermal neutrons through irradiated beryllium and beryllium oxide is studied. At low power, a local signal type of pile oscillator is operated in HIFAR to obtain information on its performance. (auth)

18428 REVIEW OF NUCLEAR PHYSICS EXPERIMENTS AT THE CP-5 REACTOR. R. E. Coté and L. M. Bollinger (Argonne National Lab., Ill.). p.135-57 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Approximately two-thirds of the beam holes at the CP-5 reactor are used for nuclear physics experiments. A discussion is given of experimental apparatus, experimental techniques, and results of measurements. Most of the experiments are concerned either with the fundamental properties of the neutron, with neutron cross sections, or with neutron capture gamma rays. The first category includes the experiment on the decay of polarized free neutrons. Techniques of producing polarized neutrons are described. Neutron cross section studies are based on a fast chopper. Transmission studies of resonances and observation of gamma spectra from resonant capture of neutrons are reviewed. A transmission experiment concerning the influence of the crystalline binding of target nuclei on the shape of resonances is outlined. Low-temperature measurements on U^{238} resonances demonstrate this effect. Another kind of cross section experiment uses capture gamma rays to determine the isotopic and spin assignments of resonances. Capture gamma rays are studied. A high-resolution bent-crystal gamma spectrometer is used to measure the low-energy gamma spectra from thermal neutron capture. These data yield energy levels and decay schemes of nuclear states. Coincidence measurements with scintillators give supplementary evidence. The lifetimes of low-energy states formed by neutron capture are measured by a delayed-coincidence technique. The dependence of capture gamma spectra on neutron energy is studied with the use of the chopper to select the neutron energy. The capabilities of this technique are increased by an order of magnitude by use of a three-dimensional pulse analyzer for storage of all information from coincidence experiments with three variables. (auth)

18429 PHYSICAL MEASUREMENTS UTILIZING FISSION NEUTRONS FROM CONVERTERS. I. I. Bondarenko and V. P. Kovalev (Academy of Sciences, Moscow). p.159-68 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In Russian)

An account is given of measurements of various nuclear constants. Converters are used as fission neutron sources. Measurements of radiative capture, fission and inelastic scattering cross sections, fission spectra, and experiments on the distribution of fission neutrons in large volumes of material are discussed. The characteristics

of the converters used are given, and some features of experiments with converters are described. (auth)

18430 REVIEW OF NUCLEAR PHYSICS PROBLEMS STUDIED WITH PILE NEUTRONS AT THE KJELLER RESEARCH ESTABLISHMENT. T. Riste (Institutt for Atomenergi, Kjeller, Norway). p.169-75 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Total neutron cross sections were determined by transmission measurements with a mechanical velocity selector in the wavelength region 3 to 14 Å. Part of the data was analyzed in terms of scattering and absorption cross sections. Activation cross sections were determined for a few isotopes by means of a scintillation counter. The data were normalized by comparison with the absorption cross section of lithium and the fission cross section of uranium. The circular polarization of gamma rays following the capture of polarized neutrons was studied. In the case of nuclei with simple decay schemes the nuclear spin could be determined. The polarized neutrons were produced by transmission through magnetized iron. The fission of U^{235} was studied. The angular dependence of coincidences between the fission neutrons is examined, as well as the energy distribution of the fission neutrons which are emitted in certain directions relative to the fragments. (auth)

18431 NEUTRON PHYSICS RESEARCH AT THE INSTITUTE OF ATOMIC PHYSICS, ACADEMY OF THE ROMANIAN PEOPLE'S REPUBLIC. D. Dragomirescu, V. Mateiciuc, and M. Cristu (Institutal de Fizică Atomică, Academia R. P. R., Bucharest). p.177-82 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Measurements are carried out on total neutron cross sections and capture gamma rays. By using time-of-flight techniques the total neutron cross sections for As, Pd, and Ca are obtained in the 0.01- to 0.1-ev energy range. The neutron spectrometer includes a mechanical chopper made of aluminum–cadmium sandwiches, a BF_3 neutron counter placed at the end of the 5-m flight base, and a 64-channel time analyzer. Agreement is found in this energy region between the experimental cross section and the 1/v law. The cross section curves plotted against time-of-flight extrapolated to t = 0 allow the nuclear radius to be computed from the potential scattering cross section. Gamma spectra emitted by thermal neutron capture in odd-even nuclei As^{75}, Mn^{55}, and Cs^{133} are investigated to obtain information about the odd neutron–odd proton interaction. From the spectra analysis the energies and intensities of capture rays are obtained in the energy range 100 to 1000 kev. With these and supporting data, the most probable scheme of the low-lying energy levels in As^{76}, Mn^{56}, and Cs^{134} are assumed. A scintillation single-crystal gamma spectrometer with 8% resolution at 1 Mev is used in these measurements. (auth)

18432 PRECISION NEUTRON CROSS-SECTION MEASUREMENTS IN THE THERMAL AND SUBTHERMAL REGION UTILIZING A CRYSTAL SPECTROMETER. G. J. Safford, B. M. Rustad, and W. W. Havens, Jr. (Columbia Univ., New York). p.203-17 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The neutron absorption and total cross sections of U^{233}, U^{235}, B^{10}, and natural B are measured with a long-wavelength crystal spectrometer at energies from 0.00082 to 0.1 ev. A measurement of $(1 + \alpha)(U^{235})$, which is by definition equal to $(\sigma_a/\sigma_f)(U^{235})$, is also made at 0.00291 ev, which yields an absolute value of $\sigma_f(U^{235}) = 591 \pm 6$ bn at 0.0253 ev. Two techniques are developed to produce monoenergetic neutron beams in the subthermal energy region. From 0.0253 to 0.1 ev, a Ge single crystal oriented to the (111) plane, for which second-order reflections are forbidden, is used for the neutron monochromator together with a neutron filter composed of large quartz crystals. From 0.0008 to 0.0253 ev, a mechanical neutron velocity selector is used to select only those neutrons from first-order reflections. Above 0.006 ev, a Ge crystal is used as a spectrometer monochromator. At lower energies, a mica crystal having a larger lattice spacing is used. (auth)

18433 DETERMINATION OF THERMAL NEUTRON ABSORPTION AND SCATTERING CROSS-SECTIONS OF RARE GASES. R. Génin, H. Beil, R. Joly, M. Ribrag, and C. Signarbieux (Centre d'Études Nucléaires, Saclay, France). p.219-23 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In French)

The EL-2 reactor crystal spectrometer was used to measure the total cross sections of rare gases as a function of neutron energy, from about 10^{-3} to 10^{-2} ev. For such elements the observed law of total cross section variation can be interpreted, and permits the determination of absorption and scattering cross sections. (auth)

18434 THERMAL-NEUTRON CAPTURE GAMMA-RAYS FROM BERYLLIUM AND NITROGEN. H. T. Motz, R. E. Carter, and W. D. Barfield (Los Alamos Scientific Lab., N. Mex.). p.225-38 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

A $\sqrt{2}\,\pi$ double-focusing magnetic spectrometer is used to analyze the energy distribution of Compton electrons from neutron-capture gamma rays. A collimated beam of gamma rays passes through the spectrometer tangential to the principal orbit. An improvement in resolution and signal-to-background ratio is obtained by detecting electrons in coincidence with back-scattered gamma rays in a defined angular interval. The magnetic field shape of the spectrometer allows the use of four adjacent electron detectors in order to improve the counting rate. Two NaI scintillation counters are used as detectors for the back-scattered gamma rays. Line widths are 14 to 30 kev in the energy interval 1 to 10 Mev. The spectrometer operates as an eight-channel device, and the data are automatically recorded and processed. Coincidence detection results in a nearly symmetrical line shape, which can be fitted with a skewed gaussian, and such curves are fitted to all observed peaks by the method of least squares. This procedure allows the data to be analyzed with great detail and gives estimates of the errors in energy and area due to the statistics of the observed points. The gamma rays from beryllium are observed. It is found that the 3365-kev transition from the first excited state is approximately 3.5 times as strong as the 3442-kev transition that feeds this level. A search for other lines discloses a transition 851 kev from the capturing state to a state of 5956 kev in Be^{10}. This transition is followed by one of 2590 kev and accounts for the added population of the first excited state. The reduced transition probability of the 851-kev gamma ray is very high. Five new gamma rays from nitrogen are observed. These fit into the level scheme of N^{15} and result from stop-over decay modes. The energy difference of the first two excited states of N^{15} is found to be 28.8 ± 0.2 kev. (auth)

18435 MEASUREMENTS OF THERMAL CROSS-SECTIONS AND RESONANCE INTEGRALS USING PILE NEUTRONS AND ACTIVATION TECHNIQUES. R. W. Stoughton, J. Halperin, R. E. Druschel, F. J. Johnston,

P. M. Lantz, J. H. Oliver, and G. W. Parker (Oak Ridge National Lab., Tenn.). p.239-46 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Various thermal and epithermal neutron flux conventions and definitions are discussed, as are the problems associated with neutron–energy cut-off filters. Effective energy cut-offs are calculated for spherical, cylindrical, and cubic cadmium and boron filters, as well as flux depressions near filters and burn-out of the filters themselves during long irradiations. The flux depression near filters is also measured. An experimental measurement of the resonance integral for fission of U^{233} of 850 b is described. (auth)

18436 ENERGY DISTRIBUTION AND (γ,γ) ANGULAR CORRELATION MEASUREMENTS FOR (n,γ) REACTIONS. B. Kardon, D. Kiss, I. Lovas, and Z. Zámori (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest). p.247-59 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The spin values of the 1.719- and 1.378-Mev nuclear levels of Ti^{49} are studied by angular correlation experiments. Neutrons leaving a reactor are led through a collimating system to a target consisting of compressed metallic powder of titanium. The gamma rays emerging from this target are recorded by two scintillation detectors placed laterally with respect to the neutron beam. One of the detectors is mounted in a fixed vertical position, while the other is movable from 90 to 270° in a vertical plane around the neutron beam as axis. The pulses of the multiplier used in conjunction with the scintillation detectors are transmitted to a fast-slow coincidence system. In each of the two side-channels a differential discriminator is mounted having its discrimination levels set at the 0.341-Mev (1.719–1.378) and 1.378-Mev lines respectively. From the angular correlation measurements made on Ti, spin values of $\frac{1}{2}$ and $\frac{3}{2}$ are assigned unambiguously to the 1.719- and 1.367-Mev levels respectively. The multipolarity of the 0.341-Mev gamma transition between the two levels is predominantly M1. The mixing ratio of the slight mixture of E2 in M1 is restricted to a definite interval, as shown by the measurement. (auth)

18437 RESEARCH ON (n,γ) REACTIONS WITH THE USSR ACADEMY OF SCIENCES IRT REACTOR. L. V. Groshev, A. M. Demidov, V. N. Lutsenko, and V. I. Pelekhov (Kurchatov Inst. of Atomic Energy, Moscow). p. 261-72 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A description is given of two magnetic spectrometers used for studying (n,γ) reactions of thermal neutrons. One of the instruments is a magnetic Compton spectrometer of high resolution, and the other is a magnetic spectrometer for measurements of internal-conversion electron spectra. The spectra obtained with these instruments are given. (auth)

18438 THE SPECTRA OF GAMMA-RAYS ASSOCIATED WITH THE THERMAL-NEUTRON FISSION OF U^{235}. R. W. Peelle, F. C. Maienschein, W. Zobel, and T. A. Love (Oak Ridge National Lab., Tenn.). p.273-97 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Measurements of the spectra of prompt and delayed gamma rays associated with the thermal fission of U^{235} are discussed. Gamma rays from 0.4 to 8 Mev occurring within about 6×10^{-8} sec of fission are studied with two-crystal Compton and three-crystal pair scintillation spectrometers, using as a source a spiral fission chamber irradiated with neutrons from a reactor thermal column. Fission-coincident gamma rays in the lower energy region from 15 to 800 kev are measured with a single NaI(Tl) scintillator sufficiently removed from a thin-walled fission chamber to allow time-of-flight discrimination against counts associated with prompt neutrons from fission. A similar beam was used to study the delayed gamma-radiation emitted within a microsecond of fission. This radiation presumably arises from isomeric states in the fission products. A number of spectra of delayed fission-product gamma rays with energies between 0.3 and 5 Mev are obtained at times after fission ranging from 2 to 1500 sec. (auth)

18439 TOTAL GAMMA-RAY SPECTRUM ABOVE 3 Mev FROM U^{235} + n. G. A. Bartholomew and P. J. Campion (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.299-307 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The total spectrum of gamma rays from fission and capture following thermal neutron absorption in U^{235} is examined between 3 and 9.5 Mev. Only one isolated gamma ray at 4.49 ± 0.07 Mev, with an intensity of 0.010 ± 0.004 quanta per absorbed neutron, is detected above an unresolved continuum that appears to terminate near 7 Mev. An upper limit for the intensity of any single gamma ray from U^{235} + n that may be present between 7 and 9.5 Mev is 10^{-4} quanta per absorbed neutron. The total energy emitted as gamma rays between 3 and 9.5 Mev is 1.5 Mev per absorbed neutron. By subtracting the known prompt-fission gamma ray spectrum it is deduced that between 3 and 5.4 Mev the ratio of capture to fission gamma ray contributions to the total spectrum continuum varies between 0.5 and 1. Above 5.4 Mev no contribution from capture gamma rays is detected; an upper limit for the intensity of any single capture gamma ray between 5.4 and 7 Mev is 0.01 per radiative capture. The most likely interpretation of the 4.49-Mev gamma ray is that it is emitted in the decay of the fission product Rb^{90}. However, its intensity and the intensities of other fission-product decay gamma rays that are not resolved appear to be rather lower than expected from knowledge of fission yields and fission–product decay schemes. (auth)

18440 MEASUREMENT OF THE NEUTRON SPECTRUM OF A CENTRE BEAM OF THE HOMOGENEOUS L-54 TYPE FRF REACTOR USING A LOW-PRESSURE CLOUD CHAMBER. M. Muellner, E. Roessle, and E. Schopper (Universität, Frankfurt am Main). p.309-11 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

A low-pressure cloud chamber was used to measure the energy spectrum from 50 kev to 1 Mev of a neutron beam coming directly from the core of a homogeneous water-boiler reactor of the L-54 type. After collimation the narrow neutron beam passed through a thin-wall expansion cloud chamber. The chamber worked at a pressure of 20 cm Hg of hydrogen. Photographs were taken by a 3-stereo optical system. Only non-diffused proton recoil tracks were used. The lengths and recoil angles of these tracks were measured by reprojecting the photographs by the same optical device. The neutron spectrum obtained was in agreement with a 1/E law. (auth)

18441 MEASUREMENT OF THE CORE NEUTRON SPECTRUM OF THE HOMOGENEOUS L-54 TYPE FRF REACTOR USING NUCLEAR EMULSIONS. E. Lohrmann, M. Muellner, and E. Roessle (Universität, Frankfurt am Main). p.313-16 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Ilford C-2 emulsions were used to measure the neutron spectrum in the core of a homogeneous water-boiler reactor of the L-54 type, from 0.7 to 5 Mev. The nuclear plates were exposed in the center of the beam-hole passing through the core tank. The emulsion served simultaneously as the radiator and the detector of the recoil protons. The spectrum of the recoil protons was measured. With the assumption of an isotropic flux the neutron spectrum follows from differentiation of the proton spectrum. The result is a 1/E spectrum at the lower part of the energy range, which decreases like a fission spectrum for energies greater than 2 Mev. (auth)

18442 THE NEUTRON-BEAM SPECTRUM FROM THE 6H DIDO HOLE. H. J. Hay, B. C. G. Haywood, and J. C. Lisle (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.317-22 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

A neutron-beam spectrum was measured with the DIDO fast chopper. The proportion of high-energy neutrons was found to be higher than expected, probably because of the proximity of a fuel element, and in the resonance region there were many dips which did not coincide with known resonances of materials in the neutron beam. (auth)

18443 NEUTRON SPECTROMETRY IN FAST REACTORS USING He^3-FILLED IONIZATION CHAMBERS. A. I. Abramov and M. G. Yutkin (Academy of Sciences, Moscow). p.323-8 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A method of measuring neutron spectra in fast-neutron reactors is described, based on the use of the $He^3(n,p)T^3$ reaction. Neutron spectra measurements in the BR-5 reactor are given and compared with calculated values. (auth)

18444 STUDIES ON SOLID-STATE PHYSICS CARRIED OUT WITH THE SACLAY REACTOR. A. Herpin (Centre d'Études Nucléaires, Saclay, France). p.337-50 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In French)

Solid-state physics experiments carried out on outgoing beams are discussed. These are being made with the experimental beams of the two Saclay reactors EL-2, with a central flux of 10^{13} n/cm^2, and EL-3, whose central flux is equal to 10^{14} n/cm^2. The experiments are carried out employing both neutron diffraction with a crystal spectrometer, and inelastic scattering with a time-of-flight spectrometer. (auth)

18445 NEUTRON-DIFFRACTION RESEARCH AT BROOKHAVEN. J. M. Hastings (Brookhaven National Lab., Upton, N. Y.). p.351-60 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (BNL-4988). (In English)

Research in neutron diffraction is reviewed. These studies include both magnetic and crystal structure determinations, using powder as well as single-crystal techniques. The magnetic structures discussed are those of the transition-metal double fluorides, some transition metal sulfates and vanadates, CrSe, and Cr metal. In addition, the use of polarized neutrons for the study of magnetic structures is discussed. The crystal structures reviewed include NaCN, KCN, and $FeSiF_6 \cdot 6H_2O$. (auth)

18446 REVIEW OF THE NEUTRON-DIFFRACTION INVESTIGATIONS PERFORMED AT THE KJELLER RESEARCH ESTABLISHMENT. J. A. Goedkoop (Reactor Centrum Nederland, Hague). p.361-8 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The JEEP reactor is used for neutron beam research. Solid-state investigations using this reactor are reviewed. Diffractometers are available for crystal structure investigations, which are concerned largely with the location of light atoms such as hydrogen in metal hydrides, phosphite and hypophosphite ions, and a few organic compounds, and oxygen in heavy metal oxides. In addition, several magnetic structures are studied. Diffuse scattering is studied in Fe_3O_4 and Fe_2O_3 in both the spin-wave and critical scattering regions of temperature. (auth)

18447 NEUTRON-DIFFRACTION INVESTIGATIONS OF SOLIDS AT THE EWA REACTOR. K. Blinowski (Inst. of Nuclear Research, Warsaw). p.369-78 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

A survey of experiments performed with reactor thermal and cold neutrons is given. The apparatus used in the crystal spectrometer method and time-of-flight method is described. Results of structural investigations, neutron moderation to liquid nitrogen temperature, and analysis of the intensity fluctuation observed in thermal neutron spectra are discussed. (auth)

18448 NEUTRON-DIFFRACTION STUDIES OF RARE-EARTH METALS AND COMPOUNDS. J. W. Cable, H. R. Child, W. C. Koehler, M. K. Wilkinson, and E. O. Wollan (Oak Ridge National Lab., Tenn.). p.379-90 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The magnetic and other related properties of the rare-earth metals and their compounds show complicated characteristics. Some of these complications can be unravelled by detailed neutron-diffraction studies with both crystalline powders and single crystals over a wide range of temperatures and in strong magnetic fields. A series of compounds having the simple rock salt structure are investigated. These include the nitrides, phosphides, and antimonides of Tb, Ho, Er, and Tm. The nitrides are found to exhibit ferromagnetic transitions, whereas with the other anions antiferromagnetic structures are observed. The magnetic transition temperatures, which vary from about 42 to 4°K, show correlations with the spin of the rare-earth ions as well as with the nature of the anions and with the crystallographic spacings. In the case of the rare-earth metals, studies are made on cerium and neodymium with powder samples only, whereas with dysprosium, holmium, and erbium data for single crystals are also obtained. In these cases it is only by the use of single crystals that unambiguous magnetic structure data can be obtained. These systems show both antiferromagnetic and ferromagnetic properties, with complicated behavior in the transition region. The antiferromagnetic structures are associated with helical and antiphase-domain characteristics, identified in the neutron-diffraction patterns as satellite-type Bragg reflections, which vary in spacing and intensity with temperature. An attempt is made to interpret some of the details of these satellite patterns. (auth)

18449 NEUTRON COOLING AND COLD-NEUTRON SOURCES. B. Jacrot (Centre d'Études Nucléaires, Saclay, France). p.393-408 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In French)

Intense cold neutron sources are useful in studying solids by the inelastic scattering of neutrons. A general survey is presented of the following aspects: theoretical considerations regarding thermalization processes at very low temperatures; experiments comparing moderators; and the operating cold neutron sources and their results. (auth)

18450 COLD-NEUTRON FACILITY FOR STUDYING THE DYNAMICS OF CONDENSED MATTER UTILIZING INELASTIC SCATTERING OF COLD NEUTRONS. M. G. Zemlyanov and N. A. Chernoplekov (Kurchatov Inst. of Atomic Energy, Moscow). p.409–14 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In Russian)

18451 NEUTRON-DIFFRACTION EXPERIMENTS ON MAGNETIC INELASTIC SCATTERING OF NEUTRONS. T. Riste, K. Blinowski, J. Janik, and A. Wanic (Institutt for Atomenergi, Kjeller, Norway). p.415–21 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Experiments involving direct observations of neutron energy changes in inelastic scattering processes require a high-flux reactor. An alternative method applicable to reactors of much lower neutron flux is offered by the neutron-diffraction technique, which implies observation of angular distribution of neutrons scattered inelastically from single crystals. This method can give results that compare with those obtained by direct observations of the energy changes. Diffraction experiments on ferri- and antiferromagnetic crystals are referred to, and the possibilities and limitations of the method are discussed. (auth)

18452 INELASTIC SCATTERING OF POLARIZED NEUTRONS BY SPIN WAVES IN COMPLEX EXCHANGE-COUPLED LATTICES. A. W. Sáenz (Naval Research Lab., Washington, D. C.). p.423–8 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

A spin-wave theory of Holstein-Primakoff type, developed for exchange-coupled lattices with an arbitrary number n of magnetic ions per primitive magnetic unit cell, is used to derive formulas relating the one-magnon zero-phonon scattering of neutrons with $f = 0$ by such lattices with the corresponding scattering for $f \neq 0$, in the case of orbitally quenched magnetic ions. Denote by the respective unit vectors e, λ, and μ the directions of neutron momentum transfer, of initial neutron polarization, and of a direction collinear with the axis of alignment of the resultant electronic spins of these ions. Summing over the final neutron spin states, the contribution of the αth normal spin-wave mode ($1 \leq \alpha \leq n$) to the intensity of neutrons scattered in a given direction with a given energy change ϵ by one-magnon zero-phonon processes is equal to $[1 + (e \cdot \mu)^2 \pm 2\omega_\alpha f(e \cdot \lambda)(e \cdot \mu)]$, multiplied by a factor independent of f and of the relative orientation of λ and μ. The signs + and − correspond to magnon absorption and emission respectively, and ω_α has the same value for magnon absorption as for magnon emission, being either 1 or −1. (auth)

18453 THE MAGNETIC STRUCTURE OF CHROMIUM. V. N. Bykov, V. S. Golovkin, V. A. Levdik, and S. I. Vinogradov (State Committee for Atomic Energy, Moscow). p.429–31 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A study of the magnetic structure of chromium was made using neutron diffraction by single crystals. The existence of splittings of the superstructure peaks was demonstrated. The results obtained are in agreement with a given magnetic structure model. (auth)

18454 COMPOSITION OF NEUTRON BEAMS FROM CRYSTAL MONOCHROMATORS. R. R. Spencer, J. R. Smith, and R. M. Brugger (Phillips Petroleum Co., Idaho Falls, Idaho). p.433–44 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The energy composition of the neutrons scattered from some monochromating crystal planes is studied. The Bragg beam from several planes in a beryllium crystal shows large fluctuations in the reflected neutron intensity as a function of Bragg angle. Many of these fluctuations are caused by other planes in the crystal competing for the available neutrons at certain energies. Multiple Bragg scattering may be shown to contribute to these fluctuations also. Calculations of the Bragg angles at which these fluctuations are expected agree well with the experimental data on the Be $(10\bar{1}1)$, $(10\bar{1}3)$, (0002) planes and the NaCl (200) and (220) planes. Since these fluctuations may occur in all orders of Bragg reflection and not necessarily at the same Bragg angle for different orders, large fluctuations in the amount of order contamination may be expected. Time-of-flight measurements of the Be $(10\bar{1}1)$ and Be $(10\bar{1}3)$ Bragg beams are made at several angles to determine the intensity of higher-order neutrons. Several measurements in the vicinity of one competition dip show a variation of nearly 40% in the ratio of second- to first-order intensity. Thus, it may be necessary to make point-by-point order corrections in some cases. The time-of flight measurements are made by mounting a 3600-rpm, straight-slit, Fermi-type chopper on the spectrometer arm. The time-of-flight of the neutrons from the chopper to the $B^{10}F_3$ detector on the end of the spectrometer arm is measured by means of a 1024-channel time-analyzer. Similar measurements are made to determine the effect of coherent inelastic scattering in the spectrometer beam. A group of neutrons attributed to coherent inelastic scattering with intensity 0.2% that of the first-order Bragg reflection is observed in the Be $(10\bar{1}3)$ beam at a Bragg angle of 23° 22′. The interpretation of this effect using the beryllium dispersion curve is discussed. (auth)

18455 SECONDARY EXTINCTION AND NEUTRON DIFFRACTION. B. T. M. Willis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.455–65 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The term "secondary extinction" denotes the loss of power owing to diffraction for a neutron beam passing through a mosaic crystal. To derive accurate estimates of the integrated intensities from single crystals (as is required, for instance, in crystal structure investigations) it is necessary to correct for the effect of secondary extinction, which is normally more serious than the effect of true absorption from nuclear capture processes. A method of correcting for secondary extinction is proposed based on the measurement of the integrated intensity for different path-lengths of the beam in the crystal. The theory of the method is developed for the two cases of small and large extinction. The measurements are carried out using a 3-circle arrangement, or Eulerian cradle; two of these circles are effectively used to bring the (hkl) normal into the reflecting position in the horizontal plane and the third circle is used to rotate the crystal about the normal to the reflecting plane while maintaining the Bragg reflecting condition. The application of the method to the correction of the intensities from several single crystals, including KBr and UO_2, is described. (auth)

18456 PULSED-REACTOR AND ACCELERATOR NEUTRON SOURCES FOR PHYSICS RESEARCH. A. W. McReynolds (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.469–89 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Intense pulses of neutrons are made possible by the de-

velopment both of pulsed-reactor systems and of accelerators with high neutron yield. The possibility of pulsing reactors depends somewhat on the development of several nearly homogeneous systems in which the pulse is automatically determined by the prompt negative temperature coefficient and the heat capacity of the reactor. Examples are the graphite-uranium TREAT, zirconium hydride-uranium TRIGA, water-uranium solution KEWB, and heterogeneous water-uranium SPERT, all of which are thermal reactors. Pulses are in the range 10 to 100 msec, 10 to 1000 Mw-sec, and peak flux 5×10^{15} to 10^{16} n/cm^2·sec. Fast reactor systems, as exemplified by the bare uranium sphere GODIVA, give pulses of the order of 1 Mw-sec energy but with duration of the order of 10 to 100 μsec and peak flux of 10^{17} or higher. The kinetics and operating characteristics of these and similar pulsed-reactor neutron sources are discussed with relation to their application in research. High-current electron linear accelerators bombarding heavy targets are neutron sources of intensity comparable to reactors. Typical pulses are 1 to 5 μsec in duration producing 10^{10} to 10^{11} fast neutrons per pulse in a region of a few cubic centimeters, and with repetition rate 100 to 1000 per sec. Characteristics of accelerators as neutron sources are described, and relative advantages of accelerators and reactors for application to various types of neutron nuclear and solid-state physics research are discussed. (auth)

18457 FLUCTUATION OF THE NEUTRON YIELD IN PULSED FAST REACTORS. L. Pal and G. Nemet (Central Scientific-Research Inst., Budapest). p.491-507 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A fast reactor working on pulsed operation provides a method of obtaining a short-period high-power neutron flux. A study is made to determine whether statistical fluctuations of neutron propagation can substantially affect the cause of the chain reaction in a pulse reactor. These statistical fluctuations are caused partly by fluctuation in the number of neutrons on fission, and partly by fluctuation in the length of chain-reaction branches. Calculations are made for a simple single-group approximation model. The reactor's finite dimensions are taken into account by introducing additional absorption. Pulse-initiating neutrons are assumed to be evenly distributed throughout the reactor. The calculations assume that every pulse-initiating neutron, independently of the rest, could with a certain probability induce a chain reaction. A simple form of time-dependence on reactivity is selected. The reactivity of the system at the start of the run is assumed to be negative. Reactivity then increases to a definite positive value, and decreases to its original negative value. The time-dependence is determined for an average number of neutrons for one run at various maximum supercriticalities, and also for the standard deviation of the number of neutrons under identical conditions. The fluctuation in the number of neutrons and fissions in a single burst must be found. Values are calculated for average relative dispersion and relative standard deviation of number of neutrons in one burst at various maximum supercriticalities. The number of neutrons in one pulse fluctuates strongly even if the average number of charge neutrons is high. The relative standard deviation of the number of fissions in a single neutron impulse is found to increase with the maximum supercriticality. The calculations can be made more precise by allowing for geometrical effects and using a multigroup approximation. (auth)

18458 TIME-DEPENDENT NEUTRON MEASUREMENTS UTILIZING A CHOPPED REACTOR-BEAM OR A PULSED ACCELERATOR. E. G. Silver, G. de Saussure, and R. Perez-Belles (Oak Ridge National Lab., Tenn.). p.509-25 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Time-dependent neutron experiments utilizing two types of pulsed sources are carried out to observe the asymptotic decay with time of the neutron population in a variety of systems. These measurements are used to determine the effective fraction of delayed neutrons per fission, the neutron generation times in four types of reactors, effects of neutron absorbers in such systems, neutron transport parameters in beryllium from −140 to 500°C, and the effects of black absorbers heterogeneously distributed in beryllium bodies. A reactor source comprises a D_2O-filled thermalization tank adjacent to the reactor, a collimator tube from this tank to the system under study, and an intervening neutron chopper in the collimator. The chopper rotor, filled with B^{10} powder, contains three parallel slits that pass bursts during 10% of the cycle. A 300-kv Cockcroft-Walton accelerator with a deuteron beam and a tritiated zirconium target is used as the alternate neutron source. The pulse duration and repetition rate are independently variable over wide ranges. Introduction of the neutron pulse to a pool reactor is accomplished by a 7.5-m beam-tube extension, which enables placement of the target adjacent to the reactor. Comparison of the same measurements made with both types of pulsing systems indicated that for experiments of this type the accelerator is preferable. The reasons are to be found in the sharper beam cut-off and the better "off-on ratio" attainable with the accelerator. Despite the fact that the geometric arrangement of the thermalizing tank and collimator excluded direct reactor radiation from the chopper, and despite the use of some 7 cm of packed B^{10} powder in the body of the chopper, an off-on ratio of only 10 is achieved. With the accelerator, on the other hand, by use of beam deflection in the pre-acceleration lens system, factors of the order of 10^4 are attained. (auth)

18459 THE RELATIVE MERITS OF CHOPPERS AND LINEAR ELECTRON ACCELERATORS FOR NEUTRON TIME-OF-FLIGHT MEASUREMENTS. P. A. Egelstaff (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.527-33 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

18460 THE ORNL FAST-CHOPPER TIME-OF-FLIGHT NEUTRON SPECTROMETER. R. Block, G. Slaughter, N. Pattenden, and J. Harvey (Oak Ridge National Lab., Tenn.). p.535-47 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The spectrometer is designed to make mono-energetic neutron measurements from thermal energies to approximately 40 kev. This is accomplished by the time-of-flight method. A collimated neutron beam from a reactor is pulsed by a mechanical rotor, the pulsed neutron beam is allowed to travel through a long flight-tube over a measured distance to a detector, and the energies of the neutrons are determined by measuring the flight-times of the neutrons. The fast chopper installation consists of an evacuated flight-path with detector stations at 12, 25, 45, and 180 m, 256- and 2048-channel time-analyzers, and two separate rotor-collimator systems designed respectively for high-resolution measurements (with a resolution ≤10 nsec/m) and for high-intensity measurements (with a resolution of ~60 nsec/m). Precise total cross section measurements in the thermal energy range are made on B^{10}, U^{233}, U^{235}, Pu^{240}, U^{234}, and Sm^{151}; the 2200-m/sec cross

sections are found to be 3850 ± 40, 587 ± 3, 693 ± 5, 290 ± 8, 110 ± 4, and 15400 ± 1500 b respectively. Total cross section measurements up to several hundred ev are made on both natural and enriched samples of nuclides such as Lu, Lu^{176}, Ta, Ta^{180}, fission product Sm, U^{233}, Np^{237}, Am^{241}, etc., for which resonance structure is observed and analyzed for resonance parameters. The scattering of neutrons from the resonances in W and Pt is measured directly, with the use of $B^{10}F_3$ proportional counters to detect the scattered neutrons. From these measurements the spin states of many of the levels in W^{184} and Pt^{196} are determined. Neutron radiative capture measurements are also made with a large volume (200-l) 4 π liquid scintillator detector. From these measurements both the "average" capture cross section in the 200- to 10000-ev region (where the resolution smears out the resonance structure) and the radiation widths of individually resolved resonances (in the energy range below ~200 ev) are determined. Measurements on η values of U^{233} from thermal energies to several ev are also performed. (auth)

18461 A MULTI-ROTOR FAST CHOPPER SYSTEM. P. A. Egelstaff, H. J. Hay, and B. C. G. Haywood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.549-57 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

A time-of-flight spectrometer is described, in which several separate rotors are operated in phase to "chop" a beam of neutrons from a reactor. The advantages of such a system over a single rotor instrument are greater safety, greater chopping speed, and the ability of the multi-rotor system to vary the spectrum of neutron velocities passed. Some details of operation and use of the multi-rotor chopper are given. (auth)

18462 THE NATURAL FREQUENCIES OF ROTORS ON FLEXIBLE SHAFTS. H. J. Hay, P. A. Egelstaff, and J. F. Raffle (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.559-76 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

It can be shown that both the speed and safety of neutron choppers can be improved if elliptical or rod-like rotors with longitudinal slots are employed. However, when such rotors are spun suspended on flexible shafts unexpected motions of the rotor may be found. These occur at speeds distinct from the critical speeds of the system, and the effects range from an inability to accelerate above a certain speed to violent displacements that can break the shaft and damage the rotor. A study of the equations of motion shows that the simple whirling speed of a disc-like rotor broadens out, for elliptical rotors, to a range of speeds over which the system is inherently unstable, and that there are other ranges of speed where interference between different natural frequencies causes undesirable motions. In general, these can be damped quite easily, but for some types of rotor-shaft assembly the amplitude may become so large that damping adequate to prevent damage can absorb all the power available from the driving motor. (auth)

18463 METHODOLOGY WORK IN THE RESEARCH LABORATORIES ATTACHED TO THE REACTOR OF THE INSTITUTE FOR ATOMIC PHYSICS OF THE ACADEMY OF THE ROMANIAN PEOPLE'S REPUBLIC. D. Bally, M. Cristu, and H. Teutsch (Institutul de Fizică Atomică, Academia R. P. R., Bucharest). p.577-83 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Plane and curved-crystal neutron spectrometers of high resolving power are studied. The calculation of the resolving-power function is made, taking into account the total reflection effect, and the optical system of the device is studied in two operating versions. The resolving power of the device is 0.53 μ sec/m if a calcite crystal is used, in which case the device can be used in an energy range extending up to 5.5 ev. The results obtained with a curved quartz-crystal are also described. A time-of-flight spectrometer for thermal neutrons is discussed. This has a 64-channel analyzer and uses a straight-slot chopper having a maximum resolving power corresponding to the relative error ($\Delta t/t$) = 0.5% in the time-of-flight for a relative transmission equal to 0.5. A curved-slot chopper for thermal and sub-thermal neutrons is under construction. A scintillation gamma spectrometer equipped with a NaI (Tl) crystal and a fast multi-channel analyzer is also described. It is used for research on gamma rays emitted when thermal neutrons are captured and for radioactivation analyses. (auth)

18464 THE JAERI NEUTRON CRYSTAL SPECTROMETER. Y. Ohno, T. Asami, and K. Okamoto (Japan Atomic Energy Research Inst., Tokyo). p.585-95 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

Adjustments necessary for instrumental alignment (i.e., tilting and direction and position of the crystal and the slit-openings) are made at the control console by remote control, and while in operation, the arm and the crystal table are turned automatically through any one of the angular increments 20, 40, and 60". The detector countings at each angular position are digitally printed after being corrected for the effects of the reactor power-level fluctuation. The accuracy of the crystal setting is ±5" of arc. Experiments and measurements of the pile-neutron spectrum at the experimental beam-hole are performed at the JRR-1 reactor (water boiler type of 50 kw), using a LiF single crystal. The full width at half maximum intensity is 24' of arc. The fluctuation of the spectrum ascribed to thermal inelastic scattering or double reflection is not very prominent in the measurement beyond the limit of statistical fluctuation. (auth)

18465 A CURVED-CRYSTAL NEUTRON SPECTROMETER. N. J. Pattenden, D. H. Saunderson, and H. J. Hay (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.597-608 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The design of a Cauchois-type focusing crystal spectrometer for neutron cross section measurements in the 0.05 to 10 ev region is described. The focusing and resolution are discussed, and it is shown that a monochromating crystal of fixed curvature can be used. The monoenergetic neutron intensities available with a neutron beam from a high-flux research reactor are calculated, and are shown to be sufficient for measurement of partial cross section and for resonance analysis up to about 10 ev. A technique for producing a beryllium curved monochromator is described, and results are given of measurements made on a trial crystal. An increase in monoenergetic neutron rates of a factor of at least 10 is shown to be attainable by the use of the Cauchois configuration. (auth)

18466 MEASUREMENT OF CAPTURE GAMMA-RAYS USING A BENT-CRYSTAL SPECTROMETER. N. C. Rasmussen, H. Mark, and A. H. Kazi (Massachusetts Inst. of Tech., Cambridge). p.609-14 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

The high flux in a nuclear research reactor makes possible the use of high-resolution but low-efficiency bent-crystal spectrographs to study neutron capture gamma rays. Cauchois-type spectrographs are described, in which an extended source is placed on the convex side of the crystal. This geometry is suited for use with a reactor. One instrument is described that uses a 4-mm-thick quartz crystal bent to a 6-m radius. The diffracted gamma rays are recorded on a nuclear emulsion. The sample is placed at the center of a reactor through-port in a flux of about 3×10^{12} thermal neutrons/cm^2·sec. The capture gamma rays produced are collimated and impinge on the crystal at the end of the through-port. The resolution of this instrument is about 0.1% at 100 kev and 4% at 3000 kev; the precision of measurements at these same energies is about 0.003 and 0.1%. (auth)

18467 AN APPARATUS FOR THE STUDY OF GAMMA-RAY SPECTRA FROM THE CAPTURE OF MONOCHROMATIC NEUTRONS. J. Monahan, S. Raboy, G. R. Ringo, and C. C. Trail (Argonne National Lab., Ill.). p.615-32 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In English)

An apparatus for measuring the gamma spectra from the capture of monoenergetic neutrons is described. The neutron beam from a reactor is collimated to 22′ and is reflected through the desired Bragg angle by a beryllium crystal. The crystal is housed in a movable shield consisting of heavy concrete loaded with lithium carbonate. The reflected beam passes through a second collimator and falls upon the capturing target, which is located in the center of the shield that houses the gamma spectrometer. The spectrometer consists of a NaI(Tl) scintillation crystal of 2.4-in. diameter and 6-in. length surrounded by an annulus of NaI of 8-in. diameter and 12-in. length with a 2.5-in.-diameter hole on the axis. The annulus operates in anticoincidence with the smaller crystal and discards those events that lose as much as 30 kev in the annulus. In this way the Compton distribution from 6-Mev gamma rays is reduced by about a factor of twenty. The data from the gamma spectrometer are punched on paper tape and the energies and intensities of the lines are computed by a digital computer. The shield for the scintillation counter is a set of concentric cylinders with walls of 9 in. of lead, 1 in. of boron carbide, and 6 in. of paraffin. A slot perpendicular to the axis of the shield permits the entrance and exit of the neutron beam. This shield, which is mechanically coupled to the monochromator, travels on a track at the end of the monochromator arm. Space is provided in the scintillation counter shield for two scintillation detectors, each with an anticoincidence annulus, and each may be surrounded by 1 in. of lithium fluoride for additional neutron shielding. Data are presented showing the background present in the apparatus and some typical gamma spectra that are observed. (auth)

18468 FAST-NEUTRON SPECTROMETRY USING A HYDROGEN CHAMBER. G. V. Anikin, Yu. A. Aleksandrov, and A. S. Soldatov (Academy of Sciences, Moscow). p.643-8 of "Pile Neutron Research in Physics." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A method is described for separating specific energy groups from a broad neutron spectrum recorded by a cylindrical, hydrogen-filled ionization chamber. The method is based on the electronic collimation of recoil protons, and is devised for measurements of the differential neutron scattering cross sections using a fast reactor as a neutron source. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 18103, 18104, 18106, 18107, 18153, 18165, 18171, 18173, 18174, 18175, 18176, 18177, 18178, 18179, 18180, and 18181.

18469 (AFOSR-1566) THE DECAY ENERGY OF Bi^{205}. Technical Note No. 8. E. C. O. Bonacalza, P. Thieberger, and I. Bergstroem (Sweden. Kungliga Tekniska Högskolan, Stockholm and Sweden. Kungliga Vetenskapsakademien. Nobelinstitutet for Fyski, Stockholm). Sept. 25, 1961. Contract [AF 61(052)-118]. 25p. (AD-266647)

The decay energy of Bi^{205} was determined by measuring the K and L x rays which follow electron capture and feed the 2567 kev and 2610 kev levels. In this way the K to L, K to total and L to total capture ratios were found. Comparing these values with theoretical predictions, a total decay energy of 2703 ± 6 kev was established. This corresponds to a neutrino energy of 46 kev for K-capture to the 2567 kev level. Since this value disagreed with the previously determined maximum positron energy feeding the 703 kev level, the positron spectrum was remeasured and a value of 976 ± 10 kev was found. This yields a total decay energy of 2701 ± 10 kev, in good agreement with the capture value. K and L x rays feeding the 1766 kev level were measured as a check of the method since, for such a large spacing, the ratios are rather insensitive to energy variations. The log ft values for the E.C. decay to the 2567 kev and 2610 kev levels were calculated yielding values of 6.60 ± 0.05 and 6.34 ± 0.06 respectively. (auth)

18470 (IA-725) BARYON CHARGE AND R-INVERSION IN THE OCTET MODEL. H. Goldberg and Y. Ne'eman (Israel. Atomic Energy Establishment, Rehovoth). Feb. 1962. 12p.

A method for the application of the group U(3) to the octet version of unitary symmetry is suggested, circumventing the difficulty implicit in the tracelessness of the SU(3)-representations linked with this model. In this way, baryon number is naturally introduced. The meaning of R-inversion (introduced by M. Gell-Mann) is generalized. (auth)

18471 (IFA/FT/39) REDUCED WIDTHS FOR FAVOURED ALPHA TRANSITION. A. Săndulescu (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1961. 18p.

A method is indicated which permits the calculation of reduced widths for favored alpha transitions. For the initial and final nuclei the wave functions given by the collective model in Nilsson's scheme are used and for the spatial internal wave function of the alpha particle an exponential-type function is applied. (auth)

18472 (IFA/FT/41) FAVOURED ALPHA REDUCED WIDTHS FOR URANIUM, PLUTONIUM, CURIUM AND CALIFORNIUM. A. Săndulescu and M. Stihi (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1962. 13p.

Reduced widths for favored alpha transitions of even-even isotopes of U, Cm, Pu, and Cf are calculated for values of the angular momentum equal to 0.2 and 4. (auth)

18473 (UCRL-Trans-819(L)) GAMMA SPECTRA IN HEAVY ION REACTIONS. Yu. Ts. Oganesyan, Yu. V. Lobanov, B. N. Markov, and G. N. Flerov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from report JINR-P-802. Apr. 1962. 29p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 5927.

18474 RELATIVISTIC EFFECTS AND MUON CAPTURE IN HEAVY NUCLEI. Paul Singer (Israel Inst. of Tech., Haifa). Bull Research Council Israel, Sect. F., 10: 59-68(Dec. 1961). (In English)

Inclusion of relativistic effects in the description of nuclear forces results in a specific expression for the nucleon energy in heavy nuclei. The validity is checked using the muon capture process as a nuclear probe. Neutron emission following muon capture in Pb and Ag is calculated using the relativistic model and compared with recent experimental measurements. No positive evidence is found for the checked relativistic effects. (auth)

18475 THE HALF-LIFE OF Ca^{41}. J. R. S. Drouin and L. Yaffe (McGill Univ., Montreal). Can. J. Chem., 40: 833-8(May 1962).

Ca^{41}, a nuclide decaying by orbital electron capture, was again identified and its half life measured. The activity of the source, a highly irradiated sample of calcium carbonate, had decayed for 10 years so that competing activities were non-existent. The measurement was made with a gas-flow proportional counter with well-determined characteristics. A value of $7.5 \pm 1.1 \times 10^4$ years was obtained. (auth)

18476 BREMSSTRAHLUNG SPECTRUM IN BETA DECAY. I. Řezanka, J. Fráňa, and J. Adam (Inst. of Nuclear Research, Czechloslovak Academy of Sciences, Řež). Czechoslov. J. Phys., 12: 101-6(1962). (In English)

The bremsstrahlung spectrum arising from the complete slowing down in aluminum of continuous-spectrum beta particles is calculated, for an arrangement in which the beta emitter is completely enclosed in an absorber. The Bethe-Heitler cross section, corrected by an empirical factor, is used. A table is given that makes possible the calculation of bremsstrahlung spectra of beta emitters having their maximal energy between 0.6 and 2.0 Mev. The error in the calculation is determined by the uncertainty in the determination of the cross section, and is about 10%. (auth)

18477 ON THE LEVEL DENSITY OF ATOMIC NUCLEI DEDUCED FROM p, α REACTIONS. E. Erba (Università, Milan), U. Facchini, and E. Saetta Menichella. Energia nucleare (Milan), 9: 171-2(Mar. 1962). (In English)

The density of nuclear levels of several isotopes are analyzed and deduced from (p,α) reactions. The study shows that the angular distributions and general shape of the energetic spectra of these reactions agree with the hypothesis that the alpha particles are emitted with an evaporative mechanism. Density levels are given for cobalt-55, cobalt-57, iron-56, manganese-53, and titanium-48 from (p,α) reactions; copper-62 and manganese-54 from (α,n) reactions; and iron-56 from (n,n') reactions. (N.W.R.)

18478 ENERGY SPECTRUM OF NEUTRONS EMITTED DURING THE d(n,2n)p REACTION AT 14 Mev. H. Jérémie, M. Heyman, and J. Kahane (Collège de France, Paris). J. phys. radium, 22: 847-8(Dec. 1961). (In French)

The energy spectrum of neutrons emitted during the d(n,2n)p reaction at 20°C in the laboratory system was determined by the time-of-flight method. The differential cross section integrated between 2 and 8 Mev is 80 ± 12 mb/sterad. This result is in agreement with the measurement of the proton spectrum emitted in the same reaction. (tr-auth)

18479 EXPERIMENT ON ELASTIC SCATTERING OF PROTONS BY O^{18}. Kohsuke Yagi, Kenji Katori, Hajime Ohnuma, Yoshio Hashimoto, and Yozo Nogami (Tokyo Univ.). J. Phys. Soc. Japan, 17: 595-603(Apr. 1962). (In English)

The differential cross section for the elastic scattering of protons by O^{18} was measured at 600 to 1450 kev at center-of-mass angles of 140.8 and 90.0°. Targets consisted of thin LiOH films on thin gold foils and BeO films on thick beryllium foils. The technique for the preparation of the thin O^{18} targets is described. Protons scattered elastically from O^{18} were selected by a 90° magnetic spectrometer. Resonances were observed at 633, ~680, ~850, 987, 1169, 1239, and 1403 kev, indicating the excitation of seven levels of F^{19}. The resonance near 850 kev showed a marked anomaly with large width, and the resonance near 680 kev was a weakly excited one with large width. Other resonances had weakly excited anomalies with small widths. (auth)

18480 ANALYSIS OF ELASTIC SCATTERING OF PROTONS BY O^{18} AND THE ENERGY LEVELS OF F^{19}. Kohsuke Yagi (Tokyo Univ.). J. Phys. Soc. Japan, 17: 604-20(Apr. 1962). (In English)

The excitation curve of the elastic scattering of protons by O^{18} is analyzed using a phase shift analysis based on the R-matrix dispersion theory. Resonance energy E_R(LAB), total angular momentum and parity J_π, total resonance width Γ, proton and alpha partial widths Γ_p, Γ_α are determined and tabulated for seven resonance levels of the compound nucleus, F^{19}, in the excitation energy range between 8.5 and 9.5 Mev. The two-level approximation to the R matrix is applied to analyze the shape of the excitation curve from the 680 and 846 kev resonances. The whole excitation curve in the proton energy range between 600 and 1450 kev, except at small resonance anomalies, is reproduced using the resonance phase shift from the two $\frac{1}{2}$+ resonances, the hard sphere scattering phase shift of s and p wave, and the Coulomb scattering amplitude. All other weakly excited resonances with small level widths are analyzed by the one-level approximation, assuming that they are superposed on the general trend of the excitation curve. Each resonance parameter is uniquely determined. A method of treating the finite energy resolution due to target thickness and beam energy spread is discussed. (auth)

18481 NUCLEAR MAGNETIC RESONANCE OF Fe^{57} IN VARIOUS FERRIMAGNETIC OXIDES. Shizuko Ogawa and Setsu Morimoto (Tokyo Univ.). J. Phys. Soc. Japan, 17: 654-9(Apr. 1962). (In English)

Enhanced nuclear magnetic resonance of Fe^{57} in yttrium iron garnet, substituted iron garnets, magnetite, and hematite were observed. In garnets, two resonances for two positions of Fe^{3+} were measured. Resonance frequencies in rare-earth-substituted iron garnets differ little from the resonance frequencies of Fe^{57} in yttrium iron garnet. Comparing relatively accurate resonance frequencies observed in various garnets, it is seen that the effective magnetic field at the nucleus is proportionally increased with the crystal lattice parameters. The fractional variation of this field over all garnets is within 4% on both sites. The resonance of Fe^{57} in magnetite is also enhanced by domain-wall excitation. Two resonance frequencies corresponding to octahedral and tetrahedral sites were observed at room temperature. Below the transition temperature, only one broad resonance was confirmed. A resonance of Fe^{57} corresponding for Fe^{3+} in hematite was observed in a sample containing a small amount of magnetite. (auth)

18482 NUCLEAR MAGNETIC RESONANCE OF Co^{59} IN DILUTE COBALT–PALLADIUM ALLOYS. Shaw Ehara and Yuzo Tomono (Tokyo Univ.). J. Phys. Soc. Japan, 17: 726(Apr. 1962). (In English)

Powdered specimens were prepared by grinding solid alloys and annealing them at 400°C for a week in evacuated silica tubes. Measurements were performed using a super-regenerative oscillator that was also used as an autodyne oscillator. A plot of the derivative of the enhanced signal at 4.2°K in the 1 at. % alloy is presented. The line shape is asymmetric. Resonance frequencies are similar to those for pure Co; contributions from surrounding Pd atoms and conduction electrons must be considered. (L.N.N.)

18483 ENERGY LEVELS OF LIGHT NUCLEI. III. Z = 11 TO Z = 20. P. M. Endt and C. Van der Leun (Rijksuniversiteit, Utrecht). Nuclear Phys., 34: 1-324(Apr. 1962). (In English)

A survey is presented of the energy levels, spectra, ft values for decay and electron capture, Q values for reactions, excitation and resonance energies, masses and mass excesses, natural abundances, nuclear moments, and other nuclear data for all nuclides having $11 \leq Z \leq 20$. An extensive bibliography is included. (T.F.H.)

18484 NEUTRON ACTIVATION CROSS SECTIONS OF Pm^{147}, Pm^{148}, AND Pm^{148m}. R. P. Schuman and J. R. Berreth (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng., 12: 519-22(Apr. 1962).

The thermal cross sections and the resonance integrals were measured for the activation of Pm^{147} to both Pm^{148} isomers. The thermal activation cross sections are: 124 ± 13 barns to 5.39-day Pm^{148} and 111 ± 11 barns to 40.6-day Pm^{148m}. The resonance integrals are: 1700 ± 250 barns to 5.39-day Pm^{148} and 1520 ± 230 barns to 40.6-day Pm^{148m}. Approximate cross sections were obtained for neutron capture by both Pm^{148} isomers. The pile cross section of 40.6-day PM^{148m} is 29,000 ± 5000 barns and is due mainly to thermal neutron capture. The pile cross section of 5.39-day Pm^{148} is 3000 ± 2000 barns and is due mainly to resonance neutron capture. (auth)

18485 ON THE LEVELS AND TRANSITIONS IN ^{161}Dy. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10), 23: 477-84(Feb. 1, 1962). (In English)

Intensities of γ rays, γ-γ coincidences, and the (57–74) kev γ-γ angular correlation were measured. The spin value of the 74-kev level is required to be $\frac{5}{2}$. Other results are discussed. (auth)

18486 NEUTRON EMISSION FOLLOWING MUON CAPTURE IN HEAVY NUCLEI. P. Singer (Israel Inst. of Tech., Haifa). Nuovo cimento (10), 23: 669-89(Feb. 16, 1962). (In English)

The nuclear picture of the Brueckner theory is used to calculate neutron emission following slow-muon capture in heavy nuclei. Results are compared with measurements at Berkeley on neutron emission multiplicities. Agreement is obtained for the high multiplicities (≥ 2), although the calculated average neutron emission is still 20% lower than the experimental findings. The mass number dependence of the emission is satisfactorily accounted for. Direct emission and possible improvements are discussed. (auth)

18487 ON THE TRAPPING OF λ^0-HYPERONS FOLLOWING THE ABSORPTIONS AT REST OF Σ^--HYPERONS IN EMULSION NUCLEI. J. Sacton (Université Libre, Brussels), M. J. Beniston, D. H. Davis, B. D. Jones, B. Sanjeevaiah, and J. Zakrzewski. Nuovo cimento (10), 23: 702-7(Feb. 16, 1962). (In English)

Hyperfragment emission and cryptofragment formation following Σ^- absorption at rest in emulsion nuclei were studied. These phenomena appear to occur less frequently than in K absorption. From studies on short prongs and Auger electrons, it is suggested that hyperfragments are emitted predominantly from light nuclei, while cryptofragments are formed preferentially in heavy nuclei. (auth)

18488 GAMMA RADIATION FROM THE DECAY OF THE ^{95}Tc GROUND STATE AND FROM THE ^{93}Tc ISOMERIC PAIR. G. B. Vingiani, S. Monaro, R. A. Ricci, and R. van Lieshout (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nuovo cimento (10), 23: 729-37(Feb. 16, 1962). (In English)

The γ spectra, following the decay of the 20-hr Tc^{95} ground state and the 2.7 hr Tc^{93} ground state and its 43-min isomeric state, were studied using scintillation techniques. The sources were produced from enriched molybdenum targets. The energies (and relative intensities in % per decay) of the γ rays from (20 ± 1)-hr Tc^{95} are: (205 ± 5) (1.0), (680 ± 20) (2.0), (765 ± 5) (82 ± 10), (840 ± 10) (10.5), (930 ± 10) (1.7), and (1060 ± 10) kev (4.0%) of which the first, second, and fourth were not previously reported. The decay of the (43 ± 2)-min Tc^{93} isomer shows γ rays of (390 ± 5) (I.T., 82% per decay) and (2660 ± 40) kev (18% per decay), that of the (2.7 ± 0.1)-hr ground state shows 2 new transitions of (860 ± 20) (2.6% per decay) and (2440 ± 30) kev (0.3% per decay) in addition to the known ones of (1350 ± 10) (60), (1490 ± 10) (30), and (2030 ± 30) (0.35%) kev. A revised decay scheme is proposed for Tc^{93}. (auth)

18489 ABSORPTION OF 10 AND 13.5 Gev PHOTONS. M. Fidecaro, G. Finocchiaro, and G. Giacomelli (CERN, Geneva). Nuovo cimento (10), 23: 800-6(Mar. 1, 1962). (In English)

The absorption coefficients of photons were measured at 10 Bev in CH_2 and C, and at 13.5 Bev in Li, C, Cu, and Pb. The detection system consisted of a pair spectrometer with two total-absorption lead glass Cherenkov counters. A band of γ rays of ±11% around the center value was used. Within experimental accuracies of 2 to 5%, the results agree with theoretical values. (auth)

18490 ENERGY DEPENDENCE OF PROMPT $\bar{\nu}$ FOR NEUTRON-INDUCED FISSION OF U^{235}. J. W. Meadows and J. F. Whalen (Argonne National Lab., Ill.). Phys. Rev., 126: 197-201(Apr. 1, 1962).

The energy dependence of $\bar{\nu}_p$, the average number of prompt neutrons per fission, for U^{235} is studied over the incidental neutron energy (E_n) range 0.03 to 1.76 Mev by measuring the ratio of prompt neutrons from neutron-induced fission of U^{235} to those from spontaneous fission of Cf^{252}. The extrapolated value at $E_n = 0$ is normalized to $\bar{\nu}_p$ for U^{235} at thermal energies. The results are fitted to an equation of the type $\bar{\nu}_p = \bar{\nu}_p(0) + aE_n$, yielding $\bar{\nu}_p(U^{235}) = 2.414 + (0.097 \pm 0.008)E_n$. For Cf^{252} spontaneous fission $\bar{\nu}_p$ is 3.754 ± 0.045. (auth)

18491 CONSERVED CURRENT HYPOTHESIS AND THE BETA DECAY OF RaE. Jun-Ichi Fujita (Indiana Univ., Bloomington). Phys. Rev., 126: 202-10(Apr. 1, 1962).

It is shown that the conserved current theory is consistent with Bi^{210} beta decay. This assertion is made by comparing theoretical predictions with experimental data obtained from electron polarization and spectrum measurements. The Coulomb terms are evaluated. The conserved and nonconserved theories are differentiated by the presence or absence of the exchange contributions. This analysis leads to a large disagreement between the shell-model prediction and the phenomenological nuclear

matrix elements. The origin of the disagreement is discussed. Several possible effects of the meson-cloud beta decay in a nucleus are also surveyed. (auth)

18492 HELIUM-ION INDUCED FISSION OF Bi, Pb, Tl, AND Au. J. R. Huizenga, R. Chaudhry, and R. Vandenbosch (Argonne National Lab., Ill.). Phys. Rev., 126: 210-19 (Apr. 1, 1962).

Fission cross sections are measured with solid-state detectors for helium-ion-induced fission of bismuth, Pb^{206}, thallium, and gold. Measurements are made at helium-ion projectile energies between 30 and 43 Mev. The fission cross sections with 42.8-Mev helium ions are 7.3, 1.8, 0.65, and 0.28 mb, respectively, and the cross sections decrease rapidly with reduced-energy projectiles. The competition between fission and neutron emission as a function of excitation energy is compared with theoretical predictions of Γ_f/Γ_n. The effect of nuclear deformation on the Fermi gas level density parameter a is discussed. Fission thresholds for At^{213}, Po^{210}, Bi^{207}-Bi^{209}, and Tl^{201} of 15.8 ± 2.0, 18.6 ± 2.0, 20.6 ± 2.0, and 19.9 ± 2.0 Mev are derived. The saddle-point masses of these nuclei relative to the reference mass surface lie on a smooth curve with the heavy element data, indicating that the shell structure is completely destroyed during the distortion from equilibrium to saddle-point deformation. An empirical equation for fission thresholds is deduced from the saddle-point mass surface, which is thought to be valid for nuclei with Z^2/A between 32 and 40. (auth)

18493 FISSION FRAGMENT ANGULAR DISTRIBUTIONS AND SADDLE DEFORMATIONS. R. Chaudhry, R. Vandenbosch, and J. R. Huizenga (Argonne National Lab., Ill.). Phys. Rev., 126: 220-7(Apr. 1, 1962).

The fission fragment angular distributions are measured with solid-state detectors for helium-ion-induced fission of bismuth, Pb^{206}, thallium, and gold. The measurements are made at helium-ion energies between 30 and 43 Mev. With 42.8-Mev helium ions the relative differential fission cross sections for gold and bismuth targets are measured at angles between 90 and 180° and the resulting angular distributions fitted by a least-squares method with Legendre polynomials. The W(174.5°)/W(90°) ratios for 42.8-Mev helium-ion-induced fission of bismuth, lead, Pb^{206}, thallium, and gold are 2.26 ± 0.07, 2.47 ± 0.08, 2.46 ± 0.08, 2.53 ± 0.08, and 2.62 ± 0.08, respectively. The relative fission cross sections at 174.5 and 90° are also measured at several lower helium-ion energies for all targets except natural lead. These data are utilized in the calculation of the energy dependence of K_0, the standard deviation of the distribution in the angular-momentum projection on the nuclear symmetry aixs at the saddle point The energy dependence of K_0 deduced from the experimental anisotropy measurements is similar to the predicted energy dependence from statistical theory if the nuclear temperature at the saddle point is proportional to the square root of the excitation energy. These results indicate that the effective moment of inertia is independent of excitation energy. With the assumption that the effective moment of inertia at the saddle point deformation (which is deduced for each target from the anisotropy measurement at the highest energy) is the rigid-body value, the stretching at the saddle point is calculated for various simple geometric configurations. For a saddle configuration of two equal tangent spheroids, the stretchings necessary to produce the observed effective moments of inertia are in agreement with liquid drop model calculations. (auth)

18494 HYPERFINE STRUCTURE AND NUCLEAR MOMENTS OF Lu^{175}. George J. Ritter (National Research Council, Ottawa). Phys. Rev., 126: 240-52(Apr. 1, 1962).

The hyperfine structures of the $5d6s^2$ D_4^2 ground state of Lu^{175} and its associated D_4^2 metastable state are studied by the atomic beam magnetic resonance method. Radio-frequency transitions belonging to seven of the eight hfs intervals are measured, as well as low-frequency ($\Delta F = 0$) transitions at various magnetic fields in both states. The analysis of these data by means of an electronic computer yields not only precise values for the different interaction constants and the electronic g factors, but also the nuclear g factor of Lu^{175}. The values for the nuclear magnetic moment found for the two states are somewhat different from one another, even though their limits of error just overlap. The reason for this difference is not fully understood. The nuclear electric quadrupole moment is calculated. The accuracy is not sufficient to allow the derivation of an octupole moment. Configuration mixing is taken into account. (auth)

18495 NUCLEAR SPIN, HYPERFINE STRUCTURE, AND NUCLEAR MOMENTS OF 6.8-DAY LUTETIUM-177. F. Russell Petersen and Howard A. Shugart (Univ. of California, Berkeley). Phys. Rev., 126: 252-7(Apr. 1, 1962). (UCRL-9869)

The atomic-beam magnetic-resonance method is used to measure the nuclear spin and hyperfine structure of 6.8-day Lu^{177} in the ground D_4^2 state and in the D_4^2 electronic state. The nuclear moments for Lu^{177} are calculated from these measurements and from known constants of Lu^{175}. (auth)

18496 COULOMB EXCITATION OF SECOND 2+ STATES IN Ge^{74}, Ge^{76}, Se^{76}, Se^{78}, AND Se^{80}. F. K. McGowan and P. H. Stelson (Oak Ridge National Lab., Tenn.). Phys. Rev., 126: 257-63(Apr. 1, 1962).

The location of a second 2+ state is established for five even-even nuclei by means of Coulomb excitation produced by 6-, 7-, and 8-Mev α particles. The relatively weak excitation of these states is detected by a coincident measurement of the cascade gamma rays. The B(E2)'s for decay of the second 2+ state to the ground state by the crossover transition are rather small, being about single-particle value or a little less. For Ge^{74}, Se^{76}, and Se^{78}, the cascade/crossover ratio for the decay of the second 2+ state is known form radioactive decay measurements. The upper cascade B(E2,2' → 2)'s exhibit enhancements comparable to those for the lower cascade B(E2,2 → 0)'s. The ratios of the B(E2)'s for the decay of the first and second 2+ states are compared to the predictions of several collective models. The B(M1,2' → 2) values for Ge^{74} and Se^{76} are small, being about 10^{-3} times the single-particle estimate. This result is in qualitative agreement with the collective models for vibrational excitations. (auth)

18497 SPONTANEOUS FISSION HALF-LIFE OF Pu^{240}. D. E. Watt, F. J. Bannister, J. B. Laidler, and F. Brown (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Phys. Rev., 126: 264-5(Apr. 1, 1962).

The spontaneous fission half life of Pu^{240} is measured by ionization chamber and coincidence techniques using sources containing microgram quantities of plutonium with 91.89 weight percent Pu^{240}. A value of (1.340 ± 0.015) × 10^{11} years is obtained. (auth)

18498 DECAY OF 18-min Br^{80}. P. N. Trehan and D. M. Van Patter (Franklin Inst., Swarthmore, Penna.). Phys. Rev., 126: 266-71(Apr. 1, 1962).

Gamma rays with energies of 0.618 ± 0.003, 0.640 ± 0.009, 0.67 ± 0.02, 0.710 ± 0.010, 1.258 ± 0.007, and 1.333 ± 0.010 Mev are observed in the decay of 18-min Br^{80}, and their intensities are determined. Levels are proposed at 1.26 and 1.33 Mev in Kr^{80}, and the branching (crossover/cascade) determined for these levels as 0.46 ± 0.08 and

0.14 ± 0.06, respectively. The 0.67-Mev gamma ray is assigned to the first 2+ state of Se^{80}, whose energy is determined as 0.667 ± 0.004 Mev from the (p,p'γ) reaction. Excitation of the second level of Se^{80} at 1.44 Mev was not observed. The measured value of 0.62-Mev γ/β^+ of 2.6 ± 0.1 has been used to evaluate log ft values for the transitions to various levels in Se^{80} and Kr^{80}. The allowed transitions from the 1+ ground state of Br^{80} to the ground state and first two levels of both Se^{80} and Kr^{80} are found to be successively hindered. (auth)

18499 EXCITATION FUNCTION OF THE REACTION $Ti^{47}(n,p)Sc^{47}$ AT NEUTRON ENERGIES BETWEEN 2.0 AND 3.6 Mev. L. González, A. Trier, and J. J. van Loef (Universidad, Santiago, Chile). Phys. Rev., 126: 271-3(Apr. 1, 1962).

The relative cross section for $Ti^{47}(n,p)Sc^{47}$ is measured by an activation method for neutron energies of 2.0 to 3.6 Mev. The absolute cross section at 3.55-Mev neutron energy is found to be 62.7 ± 9.7 mb. The cross section rises from 40.1 mb at 1.99 Mev to 69.9 mb at 3.40 Mev. A comparison is made of the observed cross sections for $P^{31}(n,p)Si^{31}$, $S^{32}(n,p)P^{32}$, $Ti^{47}(n,p)Sc^{47}$, and $Ni^{58}(n,p)Co^{58}$ with a theoretical estimate based on the statistical theory of nuclear reactions with the assumption that only the ground states and possibly the first excited states of the residual nuclei contribute to the cross section. (auth)

18500 ALPHA-EMITTING ISOMERIC STATE OF Tb^{149}. Ronald D. Macfarlane (Univ. of California, Berkeley). Phys. Rev., 126: 274-6(Apr. 1, 1962). (UCRL-9870(Rev.))

Bombardment of La^{139} targets with 80- to 140-Mev O^{16} ions resulted in the identification of a new alpha activity decaying with a half-life of 4.3 ± 0.2 min and an alpha energy of 3.99 ± 0.03 Mev. The activity was due to an isomeric state of Tb^{149}. It was proposed that the isomerism was caused by the filling of an $h_{11/2}$ proton state for the spherical Tb isotopes. (auth)

18501 HIGH-ENERGY PROTON SCATTERING FROM CARBON AND DEUTERIUM. G. Cocconi, A. N. Diddens, E. Lillethun, G. Manning, A. E. Taylor, T. G. Walter, and A. M. Wetherell (CERN, Geneva). Phys. Rev., 126: 277-8(Apr. 1, 1962).

The momentum spectra of protons scattered from carbon and deuterium at angles close to 60 mrad and for incident proton momenta between 12 and 27 Bev/c are measured. The data show agreement with calculations based on plural quasi-elastic proton-nucleon scattering within the nucleus. (auth)

18502 POSITIVE-PION CROSS SECTIONS ON COMPLEX NUCLEI. John C. Caris, Edward A. Knapp, Victor Perez-Mendez, and Walton A. Perkins (Univ. of California, Berkeley). Phys. Rev., 126: 295-302(Apr. 1, 1962). (UCRL-6366)

Absorption and diffraction cross sections were measured for positive pions at 442 Mev. The target elements used were C, Al, Cu, and Cd. The absorption and diffraction cross sections were determined by fitting the experimental data (taken at six angles) to the shape given by the optical-model theory. The nuclear radius and the falloff parameter were taken to be approximately those determined from nuclear charge distribution measurements. The experimental data were compared with the results of the optical-model theory. Experimental values for the imaginary part of the potential were in agreement with the theoretical value. However, the experimental values for the real potential increased with increasing atomic number, becoming far larger than the theoretical value. (auth)

18503 RADIATIVE CORRECTIONS TO THE COULOMB SCATTERING ASYMMETRY FUNCTION. W. R. Johnson, C. O. Carroll, and C. J. Mullin (Univ. of Notre Dame, Ind.). Phys. Rev., 126: 352-9(Apr. 1, 1962).

An evaluation of the effect of radiative corrections on the Coulomb-scattering asymmetry function is presented. The lowest order corrections consisting of those terms that are quadratic in the external field, are evaluated with the aid of the unitarity of the S matrix. Relative corrections to the asymmetry function are presented in tabular form for electron velocities in the range $0.6 \leq \beta \leq 0.9$ and electron scattering angles in the range $30 \leq \theta \leq 150°$. These corrections, which are shown to be independent of the value of the energy resolution, are found to be less than 3% for the assumed electron velocities and angles. (auth)

18504 14.7-Mev NEUTRON-INDUCED FISSION OF U^{238}. K. M. Broom (Univ. of Arkansas, Fayetteville). Phys. Rev., 126: 627-31(Apr. 15, 1962).

Fission yields of twelve mass chains from 14-Mev neutron-induced fission of U^{238} are measured with the following results: A = 89, 2.0%; 90, 3.4%; 91, 2.16%; 111, 0.6%; 113, 0.6%; 131, 2.7%; 132, 4.5%; 133, 2.6%; 134, 4.7%; 135, 5.0%; 139, 4.4%; 140, 4.3%. Fine structure in the mass yield curve in the region A = 131 to 135 is observed with a distinct peak at A = 132. The data can be explained at least qualitatively, and agrees with the fine structure observed for U^{238} spontaneous fission. (auth)

18505 NEW ISOTOPE INDIUM-106. Richard C. Caturs and J. R. Richardson (Univ. of California, Los Angeles). Phys. Rev., 126: 646-7(Apr. 15, 1962).

Indium isotope In^{106} is produced by proton bombardment of cadmium. Mass and atomic number assignments are made on the basis of the excitation function and chemical separations, and by using a target enriched in Cd^{106}. Two positron energy end points of this 5.3-min activity are measured at 4.85 and 3.1 Mev. Gamma rays at 1.65 and 1.85 Mev are resolved from a complex high-energy spectrum. (auth)

18506 SELF-CONSISTENT DETERMINATION OF THE EFFECTIVE RADII OF HEAVY NUCLEI FOR ALPHA-PARTICLE EMISSION. D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 126: 648-52(Apr. 15, 1962). (BNL-5716)

In attempts to use the absolute rate of natural alpha-particle decay to determine the "density of alpha particles on the nuclear surface" the penetrability of the effective barrier surrounding the nucleus plays a dominating role. An approach to the barrier problem is proposed based on the hypothesis that for transitions of definite type—to ground states of spherical even-even nuclei beyond the double-closed shells at Pb^{208}—the intrinsic emission probability measured in single particle units, whatever its absolute magnitude, about which no assumption is made, might be expected to be proportional only to the surface area of the nucleus. The dispersion in the reduced widths inferred from the emission rates depends on the cut-off radius $R = r_0 A^{\frac{1}{3}}$ that is chosen, so a self-consistent potential can be defined whose radius constant r_0 minimizes this dispersion. The "spherical" nuclei show a well-defined minimum to the dispersion at $r_0 = 1.57 \pm 0.06$ fermis. The deformed nuclei have a different behavior, as is expected. This self-consistent potential is very close to that derived from an optical model analysis of alpha-particle scattering; the penetrabilities for the natural alpha-particle emitters calculated with the two potentials agree to within a factor of about 2. It is shown that if the hypothesis is modified to allow a smooth dependence of the intrinsic emission proba-

bility on A of the form $1 + \epsilon A$ then the resulting minimum dispersions computed as a function of ϵ themselves show a minimum with ϵ very close to zero, thereby justifying the hypothesis in its simple form. (auth)

18507 ELECTRON SCATTERING FROM A QUANTIZED LIQUID DROP. J. D. Walecka (Stanford Univ., Calif.). Phys. Rev., 126: 653-62(Apr. 15, 1962).

The theory of an electron interacting with a quantized liquid drop is examined, the Hamiltonian being consistently written to second order in the parameters describing the distortion. When second-order terms are kept, some care is necessary in defining the observable value of the radius. Form factors, calculated in Born approximation, for all of the transitions in the drop model are given, as well as the probabilities for real photon emission. The correction to Coulomb scattering arising from the exchange of a transverse photon is also calculated. A model is made of the contribution of the nuclear magnetization to the transverse photon exchange. In general, the Coulomb scattering dominates. Spherically symmetric compression oscillations of a drop with surface tension are also discussed and the form factors for transitions are calculated. (auth)

18508 ELECTROMAGNETIC PROPERTIES OF THE LOW-LYING STATES OF $_6C_6^{12}$ IN THE OSCILLATING DROP MODEL. J. D. Walecka (Stanford Univ., Calif.). Phys. Rev., 126: 663-70(Apr. 15, 1962). (AFOSR-1499)

The electromagnetic properties of the first four states of C^{12} are discussed within the framework of the incompressible liquid-drop model. The radius of the drop is determined by the elastic electron scattering from the ground state. The surface tension and mass participating in the motion are treated as parameters and are fixed by the energy and lifetime of the first-excited state (2^+) at 4.43 Mev. This yields an inelastic-electron scattering cross section close to the experimental result. The 0^+ state at 7.66 Mev is then identified with the two-surfon state and the inelastic electron scattering cross section and matrix element for pair emission to the ground state are found to be in quantitative agreement with the experimental results. The state at 9.63 Mev is studied as being either 2^+, two-surfon state or the 3^-, one-surfon state that are predicted at this energy, and it is shown that only the 3^- state has an inelastic electron scattering cross section consistent with the experimental results. This total electromagnetic width of the 0^+ state at 7.66 Mev, which is of astrophysical interest, is calculated to be $\Gamma_{el} = 1.02 \times 10^{-2}$ ev. The other electromagnetic widths for the first four states are calculated and agreement is obtained with experimental data. The other members of the 0^+, 2^+, 4^+ triplet are unassigned. (auth)

18509 DEPENDENCE OF NEUTRON PRODUCTION IN FISSION ON RATE OF CHANGE OF NUCLEAR POTENTIAL. Robert W. Fuller (Columbia Univ., New York). Phys. Rev., 126: 684-93(Apr. 15, 1962).

A study is made of the possibility of pre-scission neutron emission caused by excitation of individual nucleons in the dividing nucleus by nonadiabatic changes in the nuclear potential. It is questioned whether enough energy can be transferred to some neutrons to free them by the nonadiabatic distortion of the potential as the nucleus fissions. To study this possibility, a square well containing a Fermi sea of nucleons in the middle of which is "erupting" an inverted square well "volcano" is considered. It rises and divides the original square well into the two fission fragments. The energy transferred to the nucleons can be calculated analytically for the two limiting cases, adiabatic and sudden changes of potential. The transition between these limiting situations is studied on a computer. It is found that there exist reasonable rates of rise of the volcano (i.e., scission times $\simeq 5 \times 10^{-22}$ sec) for which the number of neutrons ejected is of the same order of magnitude as the total number of neutrons ejected on the average per fission as a result of all mechanisms. By varying the ratio of the width of the volcano to the width of the square well, or by smoothing the volcano out in space (rounded volcano instead of an inverted square well volcano), the number of particles ejected can be changed also. For a particular set of parameters, consistent with the experimental facts, it is found that about 1% of the neutrons in the nucleus are ejected. For a heavy nucleus such as Cf^{252} this corresponds to about 1.5 neutrons per fission. It is not proposed that all prompt fission neutrons are ejected by this mechanism, nor even a fraction necessarily anywhere as large as this example might suggest; but only that some fraction of the neutrons is certainly produced by this mechanism. (auth)

18510 MIKE RESULTS—IMPLICATIONS FOR SPONTANEOUS FISSION. David W. Dorn (Univ. of California, Livermore). Phys. Rev., 126: 693-7(Apr. 15, 1962). (UCRL-6464)

The "Mike" thermonuclear explosion produced isotopes through mass number 255. Since neutron irradiation time is short compared with possible beta-decay lifetimes, it is concluded that, through A = 255, nuclei far from the line of beta stability on the neutron-rich side are at least as likely to decay by negatron emission as by spontaneous fission. (auth)

18511 LOCATION OF SINGLE-PARTICLE LEVELS IN MEDIUM MASS NUCLEI. B. L. Cohen, R. H. Fulmer, and A. L. McCarthy (Univ. of Pittsburgh). Phys. Rev., 126: 698-708(Apr. 15, 1962).

The levels of Ni^{59}, Ni^{61}, Fe^{57}, and Ti^{49} are studied with (d,p) reactions. Angular distributions and absolute cross sections are analyzed with the aid of distorted-wave Born approximation calculations. Essentially all levels in the Ni isotopes up to about 1 Mev binding energy are assigned to a shell-model state and their reduced widths are measured. From this, the "center of gravity" of each shell-model state is determined. The results are close to theoretical expectations. For example, the results explain the large energy gap between major shells, the energy of the $3s_{1/2}$ state, and the semiclosed-shell behavior of 40 and 56 neutrons. The widths of the energy distributions of levels belonging to single shell-model states agree with the predictions of the giant resonance theory. (auth)

18512 PHOTONUCLEAR ACTIVATION BY 20.5-Mev GAMMA RAYS. W. E. Del Bianco and W. E. Stephens (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 126: 709-17(Apr. 15, 1962).

The photonuclear activation cross section of elements whose (γ,n) cross sections lead to a suitable positron activity is measured using monochromatic gamma rays from the $T^3(p,\gamma)He^4$ reaction. The gamma rays are monitored by a 3-in. diam by 4-in. long sodium iodide crystal and calibrated with a $4\frac{1}{2} \times 6$ in. crystal whose response curve to the γ rays is determined. The absorption coefficient of these photons in NaI is determined by a good-geometry transmission experiment. The positron activity is determined by a coincidence detector, consisting of two 5-in. diam by 2-in. long NaI crystals set on the annihilation radiation photopeaks. This detector is calibrated against a F^{18} positron source standardized in a 2π flow counter. The $C^{12}(\gamma,n)C^{11}$ and $F^{19}(\gamma,n)F^{18}$ reactions are investigated from 20.1 to 21.2 Mev. Structure is not observed. The (γ,n)

activation cross section is measured at 20.5 Mev for O^{16}, Cr^{50}, Fe^{54}, Cu^{63}, Zn^{64}, Mo^{92}, Sb^{121}, and Pr^{141}, giving cross sections of 0.60 ± 0.12, 29.1 ± 6.0, 30.0 ± 4.8, 52.5 ± 2.5, 35.7 ± 1.8, 35.4 ± 2.5, 33.4 ± 2.7, 51.7 ± 5.5 barns, respectively. (auth)

18513 ELASTIC AND INELASTIC SCATTERING OF FAST NEUTRONS FROM Th^{232}. Alan B. Smith (Argonne National Lab., Ill.). Phys. Rev., 126: 718-25(Apr. 15, 1962).

The elastic and inelastic scattering of neutrons from thorium is studied from 0.3 to 1.6 Mev. Fast time-of-flight techniques are utilized in conjunction with an electromagnetic pulsing and bunching system for the production of short and very intense neutron bursts. The differential elastic cross section is determined as a function of incident neutron energy. The cross sections for inelastic scattering resulting in the excitation of residual nuclear levels at 50 ± 2, 170 ± 10, 720 ± 20, 790 ± 20, 820 ± 20, 1050 ± 50, and 1150 ± 50 kev are measured. The angular distribution of inelastically scattered neutrons resulting in the excitation of the lower two nuclear levels is determined. The measured individual inelastic excitation functions are combined to obtain the total inelastic scattering cross section as a function of incident neutron energy. (auth)

18514 LIFETIMES OF SOME ROTATIONAL LEVELS. M. Birk, A. E. Blaugrund, G. Goldring, E. Z. Skurnik, and J. S. Sokolowski (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev., 126: 726-8(Apr. 15, 1962).

The lifetimes of a number of rotational nuclear levels are measured in a pulsed-beam experiment. Gamma rays are counted and timed in a cooled unactivated NaI crystal. The excited states investigated are the first-excited levels in Gd^{158}, Yb^{172}, Yb^{174}, Yb^{176}, Hf^{177}, W^{182}, W^{184}, and W^{186}. (auth)

18515 FISSION OF Ag AND Br IN NUCLEAR EMULSION BY 1.0–3.0-Bev PROTONS. E. W. Baker and S. Katcoff (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 126: 729-34(Apr. 15, 1962). (BNL-5829)

A study is made of the fission stars produced in a low-sensitivity nuclear emulsions by protons at 1 to 3 Bev. These events are characterized by two densely ionizing tracks in approximately opposite directions. The fractions of the inelastic cross section of Ag and Br leading to fission at 1.0, 2.0, and 3.0 Bev are 0.03, 0.06, and 0.11, respectively. Symmetric fission is most probable: in 41% of the events the ratio of track lengths is 1.0 to 1.5; in 27% the ratio is 1.5 to 2.0. The fission fragment velocity distribution (mean of 0.044c) is derived from the range distribution (mean of 9 μ). The average angle between the fission fragments deviates from π by 42°, indicating that the center-of-mass system is moving at a mean velocity of 0.016c approximately along the line bisecting the angle between the fragments. From a study of the energy spectrum of the alpha particles and of their angular distribution with respect to the fission fragments it appears that about 75% of the alphas are emitted prior to fission and about 25% simultaneously with fission. (auth)

18516 FIXED-ANGLE DISPERSION RELATIONS FOR NUCLEON COMPTON SCATTERING. [PART] I. A. C. Hearn (Univ. of Cambridge, Eng.) and E. Leader. Phys. Rev., 126: 789-805(Apr. 15, 1962).

The Mandelstam representation is used to derived fixed-angle dispersion relations for the twelve scalar amplitudes describing the process $\gamma + N \rightarrow \gamma + N$. The electromagnetic interaction is calculated to order e^2. The strong interactions are estimated by including one- and two-pion exchange on the left-hand cut. These depend on the $\pi^0 \rightarrow 2\gamma$ decay lifetime and on the $T = 0$ $\pi\pi$ phase shift and the total cross section for photoproduction of pions on pions, respectively. The right-hand cut is estimated by allowing the exchange of a nucleon and a pion-nucleon pair, which depend on the amplitude for meson photoproduction on nucleons. The low-energy limit theorem provides an estimation of the subtractions required in the dispersion relations. The representation is thought to be accurate for barycentric photon energies up to approximately 300 Mev. (auth)

18517 NEUTRINO-INDUCED REACTION IN C^{12}. H. Ueberall (Univ. of Michigan, Ann Arbor). Phys. Rev., 126: 876-8(Apr. 15, 1962).

The reaction with C^{12}, leading to the ground state of N^{12}, of neutrinos from stopped pion and muon sources is noted as a possible means for proving the identity of "muon" and "electron" neutrinos. The cross section and angular distribution of this reaction are investigated, and the total reaction probability is shown to be reduced by nuclear structure effects below the free-nucleon value. Other possible targets for the neutrino-induced reaction are mentioned. (auth)

18518 ELASTIC SCATTERING OF 14.5-Mev POLARIZED PROTONS BY PAIRS OF ISOTOPES AND ISOBARS. L. Rosen and W. T. Leland (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 8: 379-81(May 1, 1962).

A beam of 14.5-Mev polarized protons was generated by α-p interactions, and scattering from pairs of isotopes and isobars was measured. Results indicated that a comparison of left-right asymmetry, for any given pair, reflects a difference or similarity in nuclear structure. Data are presented in graphical form. (L.N.N.)

18519 NUCLEAR STRUCTURE EFFECT IN THE INTERNAL CONVERSION OF THE 81 Kev TRANSITION IN Cs^{133}. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sec. A, 55: 99-105(Feb. 1962). (In English)

Experimental results of angular correlations involving K-conversion electrons in Cs^{133} were interpreted using nuclear structure-dependent conversion electron parameters and conversion electron mixing amplitudes. Calculations and results are presented. The interpretation leads to the nuclear structure parameter $-5.97 < \lambda < +3.41$, indicating that the intranuclear part of the internal conversion process is hindered with respect to Weiskopf estimates. (auth)

18520 THE SPIN-FLIP SCATTERING OF HIGH ENERGY PROTONS BY LIGHT NUCLEI. Mitsuji Kawai (Tokyo Inst. of Tech.), Tokuo Terasawa, and Kouichi Izumo. Progr. Theoret. Phys. (Kyoto), 27: 404-21(Feb. 1962). (In English)

The spin-flip inelastic scattering of high-energy protons is investigated for the 15.1-Mev excitation of C^{12} and the 9.2-Mev excitation of N^{14}. The electromagnetic interaction is too weak to account for the observed cross sections. The spin-flip cross sections due to the $(\sigma_1 \cdot \sigma_2)$ $(\tau_1 \cdot \tau_2)$ part of the nuclear interaction are calculated using the impulse approximation. For C^{12}, the cross section can be calculated without referring to any special nuclear model from the ft-value of the β-decay of B^{12} or N^{12} to the ground state of C^{12}. The result agrees with the experimental cross section showing the validity of the assumptions involved. The spin-flip scattering is the only process showing the angular distribution with maximum at 0° leaving the residual nucleus in a discrete low-lying excited state. The nuclear matrix element of the transition estimated conversely from the observed cross section may be used as a datum for the relevant nuclear states. The separate contributions

of spin and orbital angular momenta to the M1 γ-transition between the relevant states is estimated to be of the ratio 1 to 0.3 for C^{12} and N^{14}. Approximations used in the calculations and on the nuclear states relevant to the excitations are discussed. (auth)

18521 ALPHA-CLUSTER AND NUCLEAR SURFACE. Kichinosuke Harada (Japan Atomic Energy Research Inst., Tokyo). Progr. Theoret. Phys. (Kyoto), 27: 430-2(Feb. 1962). (In English)

It is shown that the internal probability density of α particles emitted from heavy nuclei has a maximum at the nuclear surface. The radial dependence of the overlap integral of the wave functions for four nucleons at the top levels of heavy nuclei and α particles was calculated using the harmonic oscillator shell model. (L.N.N.)

18522 INELASTIC SCATTERING OF 13.6-Mev DEUTERONS OF NICKEL ISOTOPES. Yu. V. Gofman, O. F. Nemets, and Yu S. Stryuk (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 653-6(Mar. 1962). (In Russian)

The angular distributions of 13.6-Mev deuterons inelastically scattered on Ni^{58}, Ni^{60}, Ni^{62}, and Ni^{64} are investigated. The results (especially those pertaining to small angles) indicate that an electric interaction mechanism between deuterons and nuclei plays a significant role. (auth)

18523 ELASTIC SCATTERING OF DEUTERONS. III. Yu. V. Gofman and O. F. Nemets (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 657-8(Mar. 1962). (In Russian)

Angular distributions of 13.6-Mev deuterons elastically scattered by Ni^{58}, Ni^{60}, Ni^{62}, and Ni^{64} are obtained. No differences in large angle scattering are observed in the case of deuterons. (auth)

18524 RESONANCE SCATTERING OF γ-QUANTA IN Te^{125}. Pham Zuy Hien, V. G. Shapiro, and V. S. Shpinel (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 703-6(Mar. 1962). (In Russian)

The Mossbauer effect for 35.5-kev γ rays from Te^{125m} is observed by recording the x rays emitted after conversion in the resonance on the scattering nuclei. The values $f = 0.12 \pm 0.03$ (for a temperature $-190°C$) and $f = 0.067 \pm 0.008$ (room temperature) have been obtained for TeO_2. A half life $(1.4 \pm 0.2) \times 10^{-9}$ sec is obtained for the 35.5-kev level. (auth)

18525 PHOTOPROTONS FROM Rh, Pt, AND Pb. V. G. Shevchenko and B. A. Yurev (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 707-12(Mar. 1962). (In Russian)

The angular and energy distributions and yields of photoprotons from Rh, Pt, and Pb are measured for peak bremsstrahlung spectra energies 22.5 and 33.5 Mev. The maxima of the photoproton production cross sections are located at γ energies above 22 Mev. In this region γ absorption by heavy nuclei is mainly of a quadrupole nature. The contribution of quadrupole absorption increases with Z. (auth)

18526 COMPARISON OF THE EXCITATION ENERGIES OF B^{11} PRODUCED IN THE REACTIONS $C^{12}(\pi^-,n)B^{11}$ AND $C^{12}(p,2p)B^{11}$. A. T. Varfolomeev (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 713-14(Mar. 1962). (In Russian)

The excitation energies of B^{11} from the reaction C^{12} $C^{12}(\pi^-,n)B^{11}$ are measured with nuclear emulsions. The measurements are performed for two cases of decay of B^{11}. In one case B^{11} decays into two α particles and a triton, and in the second into Li^8 and He^3. The results are compared with the B^{11} excitation energy distribution in the $C^{12}(p,2p)B^{11}$ reaction. A possible mechanism of excitation of nuclei at energies of 25 to 40 Mev is considered. (auth)

18527 HIGH ENERGY FRAGMENTS EMITTED DURING THE ABSORPTION OF SLOW π^--MESONS BY O^{16} NUCLEI. A. T. Varfolomeev (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 715-16(Mar. 1962). (In Russian)

The disintegration of a nucleus by a slow π^- meson is analyzed. The analysis indicates that the O^{16} nucleus is disintegrated into Li^8, Be^7, and n. The kinematic characteristics of the disintegration products are such that the Li^8 and Be^7 fragments could be produced only as a result of direct interaction between the π^- meson and two nucleon groups, the masses of which are approximately equal to the masses of the observed fragments. (auth)

18528 INVESTIGATION OF MULTIPLE SCATTERING OF 100–200 kev PROTONS ON CARBON. A. A. Bednyakov, A. N. Boyarkina, I. A. Savenko, and A. F. Tulinov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 740-6 (Mar. 1962). (In Russian)

The angular distributions of 100 to 200 kev protons, multiply scattered in polystrene films, are obtained by a photographic method. There is a discrepancy ~20 to 30% between the experimental results and the predictions of theory. This discrepancy is a consequence of application of the Thomas–Fermi model in the theory. Agreement between the theoretical and experimental data is obtained for proton energies up to ~90 kev if a carbon potential obtained by the Hartree–Fock method is employed. The discrepancy increases with further decrease of the energy, the experimental angular distributions becoming broader than the theoretical. (auth)

18529 INVESTIGATION OF THE PHOTOEFFECT ON LIGHT NUCLEI. A. N. Gorbunov, V. A. Dubrovina, V. A. Osipova, V. S. Silaeva, and P. A. Cherenkov. Zhur. Eksptl'. i Teoret. Fiz., 42: 747-57(Mar. 1962). (In Russian)

A cloud chamber is employed to measure the absolute yields of various photonuclear reactions in helium, nitrogen, oxygen, and neon, and also to determine σ_0, σ_{-1}, and σ_{-2}. The experimental values are compared with the theoretical ones calculated using the summation rules for electric dipole absorption. The mean square charge distribution radii in N^{14}, O^{16}, and Ne^{20} nuclei are determined. (auth)

18530 ON THE EQUILIBRIUM SHAPE OF ATOMIC NUCLEI. V. G. Latysh (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 777-8(Mar. 1962). (In Russian)

Single-particle energy levels in an infinitely deep nonspherical rectangular well are calculated by diagonalizing the energy matrix and taking into account spin-orbit coupling. The dependence of total energy on the nonsphericity parameters is determined for various nucleon configurations. The equilibrium shape of a nucleus in such a model is considered. (auth)

18531 ISOTOPIC SHIFT OF SPECTRAL LINES AND THE COMPRESSIBILITY OF DEFORMED NUCLEI. E. E. Fradkin. Zhur. Eksptl'. i Teoret. Fiz., 42: 787-98(Mar. 1962). (In Russian)

A simple formula for the isotopic shift constant is obtained which depends only on the mean square nuclear radius and its relative variation in the series of isotopes. Conclusions regarding the compressibility of deformed nuclei are drawn by comparing the formula with the experimental data. Agreement between the experimental and calculated values of the isotopic shift for 23 isotope pairs of spherical and deformed nuclei can be attained by intro-

ducing empirical parameters of regular compressibility and deformation compressibility. (auth)

18532 ON DECELERATION OF ANTIPROTONS IN MATTER. Yu. D. Fiveiskii (Moscow Inst. of Engineering Physics). Zhur. Eksptl'. i Teoret. Fiz., 42: 799–802 (Mar. 1962). (In Russian)

Slowing down of antiprotons in matter from nonrelativistic energies is considered. It is shown that in this energy interval the antiprotons are mainly absorbed by nuclei. It is also shown that the number of antiprotons only slightly changes during their slowing down. The behavior of the cross section for capture of low-energy antiprotons in atomic shells is also clarified. (auth)

18533 ON A POSSIBLE INTERPRETATION OF EXPERIMENTS ON INELASTIC SCATTERING OF FAST PROTONS ON LIGHT NUCLEI. L. Majling (L. Mailing) (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, [Prague]). Zhur. Eksptl'. i Teoret. Fiz., 42: 831–2 (Mar. 1962).

It is shown that a possible explanation of the splitting of the ~20-Mev level observed in inelastic scattering of protons by light nuclei is the anisotropic proton distribution in the nucleus. (auth)

18534 GIANT RESONANCE IN PHOTODESINTEGRATION OF THE Zr^{90} NUCLEUS. K. V. Shitikova (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 868–70 (Mar. 1962). (In Russian)

The position and parameters of the giant resonance in the photoabsorption cross section for Zr^{90} are calculated within the framework of the shell model by taking into account residual interaction. The results are in agreement with experiments. (auth)

18535 KINETICS OF NEUTRONIZATION AT SUPERHIGH DENSITIES. D. A. Frank-Kamenetskii. Zhur. Eksptl'. i Teoret. Fiz., 42: 875–9 (Mar. 1962). (In Russian)

The time course of transformation of nuclei into neutrons as a result of compression of matter to very high densities is computed. The matrix elements are derived from the inverse β-decay processes. For helium and carbon the neutronization processes occur during times of the order of ten thousandths of a second, and for hydrogen and iron during many seconds after the thermodynamically required limiting density is attained. The results may be useful in analysis of the mechanism of gravitational collapse of a star after exhaustion of all energy sources. (auth)

18536 QUANTUM STATISTICAL THEORY OF CROSS RELAXATION. B. N. Provotorov (Inst. of Chemical Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 882–8 (Mar. 1962). (In Russian)

An equation set describing cross relaxation in spin systems is derived from the quantum-mechanical equation for the density matrix. These equations differ from those derived by Bloembergen et al., from qualitative considerations in that they contain additional terms which appear as a result of consistently taking into account the change in the mean dipole–dipole interaction energy during cross relaxation. (auth)

18537 CROSS SECTIONS OF NEUTRON REACTIONS WITH NUCLEI AT 8.3 Bev. V. S. Pantuev and M. N. Khachaturyan (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 909–10 (Mar. 1962). (In Russian)

The total and inelastic reaction of 8.3 Bev neutrons with C, Al, Cu, Sn, and Pb were measured, using the method of knocked-out particles. The measurements were carried out under good and bad geometry. The C and Pb cross sections were also measured at intermediate values of θ. (R.V.J.)

18538 FINE STRUCTURE OF NUCLEAR MASS APPEARING IN α DECAY. V. N. Andreev. Zhur. Eksptl'. i Teoret. Fiz., 42: 913–15 (Mar. 1962). (In Russian)

It is shown that energies of subsequent α decays in nuclei with odd $A > 230$, comply, within experimental error, with the ratio $Q_\alpha(A + 4i, Z + 2i) = Q(A,Z) + i\xi + m\epsilon$, where i and m are integral positive or negative numbers. The magnitude of ϵ determined by the method of least squares is $\epsilon = 0.174 \pm 0.002$ Mev. The magnitude ξ has different values for nuclei with $A = 4n + 1$ and $A = 4n + 3$ and is equal to 0.154 and 0.049 Mev, respectively. Established data are compared with data calculated according to the above formula. The formula binds α-decay energies within the limits of one chain of α active nuclei. (R.V.J.)

18539 BETA DECAY FOR PEDESTRIANS. Harry J. Lipkin. Series in Physics. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1962. 124p. $6.00.

The aim of the pedestrian approach is to prevent simply, but without oversimplification, those aspects of beta decay which can be understood without reference to the formal theory, i. e. those relations which follow directly from conservation laws and elementary quantum mechanics. The pedestrian treatment is not intended as substitute for a complete treatment nor as a watered down treatment. (N.W.R.)

18540 THE BETA-DECAY OF PROTACTINIUM ISOTOPES (thesis). Ong Ping Hok (Vrije Universiteit, Amsterdam). The Hague, Uitgeverij Excelsior, [1955]. 108p.

After reviewing several coincidence arrangements in general, a short description of the arrangement used in the investigation is given. Measurements and the interpretation of the radiations in the decay of protactinium isotopes with mass numbers 227, 228, 229, 230, 232, 234, and 235 are described. When possible, a decay scheme is proposed and discussed for each isotope. Rotational levels, occurring in the beta decay of the protactinium isotopes with even mass numbers, are also described. A short review is also made of the processes that can occur in a radioactive disintegration and of the fundamentals of the individual particle and collective model. A detailed description is given of a 30 cm double focusing beta spectrometer that was used in the investigation. The main results of the beta and gamma spectrometric measurements are tabulated. 115 references are given. (P.C.H.)

Particle Accelerators

Refer also to abstract 18092.

18541 (TID-14258) ELECTROLYTIC TANK CONSTRUCTION, CALIBRATION AND APPLICATIONS. H. R. Fechter and M. Striegl (Argonne National Lab., Ill.). Oct. 13, 1958. Contract [W-31-109-Eng-38]. 21p.

The tank is constructed of $\frac{3}{8}$-in. thick phenolic resin. To minimize distortions caused by probe electrode insertion, very fine W wire was used. An absolute calibration of the electrolytic tank was carried out. The applications of the tank include extraction and control of protons; electrostatic inflector design, design of accelerating electrodes, evaluation of transit time factors, and determination of amplifier gain functions. (J.R.D.)

18542 (UCRL-Trans-813) METHODS OF CHANGING THE DURATION OF THE TIME OF THE BEAM INTERACTION WITH THE TARGET IN A 10 Bev SYNCHROPHASOTRON. G. S. Kazanskii, A. I. Mikhailov, K. P. Myznikov, and A. P. Tsarenkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). Translated by D. A. Nimidoff (Univ. of California Lawrence Radiation Lab., Berkeley) from report JINR-P-849. 1961. 41p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12580.

18543 (UCRL-Trans-814) FOCUSING AND ADJUSTMENT OF THE INJECTOR BEAM OF THE LINEAR ACCELERATOR. Yu. N. Antonov, L. P. Zinov'ev, I. V. Kozlukhov, V. P. Rashevskii, V. P. Sarantsev, and Chung-mu Chang (Chzhan Chzhun-Mu) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). Translated by D. A. Nimidoff (Univ. of California Lawrence Radiation Lab., Berkeley) from report JINR-P-855. 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12582.

18544 (UCRL-Trans-818) RESONANCE HIGH-FREQUENCY DISCHARGE IN A CYCLOTRON. B. A. Zager and V. G. Tishin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). Translated by Marie Kassatkin (Univ. of California Lawrence Radiation Lab., Berkeley) from report JINR-P-811. 1961. 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 9473.

18545 COMPARISON OF SIMON'S AND VAN de GRAAFF'S THEORIES OF THE ELECTROSTATIC GENERATOR. K. S. Subudhi and P. Tiwari (Banaras Hindu Univ., India). Am. J. Phys., 30: 333-5(May 1962).

Essential differences between the Van de Graaff and Simon theories of the electrostatic generator were considered. According to Van de Graaff's theory, the sphere acts as a Faraday's ice-pail; the rise of voltage is linear with time; the voltage attainable in the generator is equal to the breakdown potential of the sphere if there is no leakage of charge through the insulating support, etc.; and the voltage is a constant independent of the spraying voltage. According to Simon's theory, the basic principle is the Volta's condensing electroscope principle; the rise of voltage is exponential with time; the attainable voltage is proportional to the spraying voltage; and the constant of proportionality does not depend on the capacity of the sphere, but depends on the positions of the spraying point, collecting point, and the sphere. Experiments produced results qualitatively in accordance with the Simon theory. (auth)

18546 THE RUTHERFORD HIGH ENERGY LABORATORY OF THE NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE. Contemporary Phys., 3: 145-9 (Dec. 1961).

The 50 Mev proton linear accelerator and the 7 Bev proton synchrotron (NIMROD) of the Rutherford High Energy Laboratory of the National Institute for Research in Nuclear Science are briefly described along with the Laboratory. The historical background of the Laboratory is presented along with the policies to be instituted in nuclear physics research. (N.W.R.)

18547 ELECTRON MOTION INSIDE A SYNCHROTRON CLUSTER. A. S. Chumakov (Tomsk Polytechnic Inst., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 6, 113-17(1961). (In Russian)

Approximation formulas were derived, considering nonlinearity, for the phase oscillation periods and electron phase in the cluster at arbitrary times. (tr-auth)

18548 RADIATION FROM ELECTRON BUNCHES IN THE MICROTRONS. S. P. Kapitsa and L. A. Vainshtein (Inst. of Problems in Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 821-30(Mar. 1962). (In Russian)

The coherent radiation forces from electron bunches moving in a magnetic field can remove the electrons from the acceleration mode of operation, and can determine the upper limit for the accelerated particle current in a microtron. The radiation force acting on an ultrarelativistic electron bunch with a spherically symmetric (laboratory coordinate system) charge distribution is determined for the case of translational motion of the bunch in a circle. The limiting current in a microtron is estimated to be ~1 amp. (auth)

18549 ARRANGEMENT FOR ACCELERATING PARTICLES. Nico Frederick Verster (to North American Philips Co., Inc.). U. S. Patent 3,024,379. Mar. 6, 1962.

A cyclotron or synchrocyclotron is designed with a device for extracting the accelerated particles into a beam with a high efficiency, e.g., ≥20%, while restricting the spiral paths in the axial direction. The cyclotron includes a regenerator of ferromagnetic material for producing a magnetic field outside of the spiral paths which increases through a small azimuthal angle. The means for restricting the spiral paths in the axial direction comprises ferromagnetic members positioned to decrease the magnetic field outside the spiral paths. (D.L.C.)

18550 OPTICAL ALIGNMENT OF CHARGED PARTICLE ACCELERATORS. Peter H. Rose (to High Voltage Engineering Corp.). U. S. Patent 3,034,846. May 15, 1962.

A line-of-sight method is outlined for aligning a tandem accelerator with its analyzing magnet. The method comprises optically ascertaining a beam-entrance point and a beam-exit point with respect to the magnet, establishing two pairs of reference points fixed relative to the magnet and aligned respectively with the calculated beam-entrance and -exit trajectories, directing the charged particle beam between the pole faces of the magnet along the beam-entrance trajectory, and adjusting the second pair of reference points to align with the observed beam-exit trajectory. Thus, the magnet may be optically aligned for any charged particle beam. (D.L.C.)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 18116 and 18117.

18551 (60-RL-2545G) THE INTERACTION BETWEEN THE SOLENOIDAL ELECTRIC FIELD AND A CYLINDRICAL PLASMA OF FINITE DIMENSIONS. K. B. Persson (General Electric Co. Research Lab., Schenectady, N. Y.). Oct. 3, 1960. 32p.

The solenoidal electric field applied to a plasma with finite dimensions and rotational symmetry is the only field and plasma configuration in which it is possible to avoid the limitations on the measurements, which generally are caused by the electric polarization of the plasma. The limits associated with the electric polarization are then replaced by the limits associated with the magnetic polarization or the skin depth. The interaction between the solenoidal electric field and a plasma cylinder of finite dimensions

in the presence of a longitudinal magnetic field can, in the low-pressure and high-frequency ranges, be expressed in terms of expansions of pure TM and TE modes. Some of these modes can be used for measurements on the plasma in the same manner as the conventional microwave cavity method, while others, the magnetohydrodynamic modes, are more suitable for measurements of the electron density and the collision frequencies through the wave velocity and the damping of waves. The TM-mode exhibits, besides the ordinary magnetohydrodynamic wave where the wave velocity depends on the mass of the ion, a magnetohydrodynamic wave with the wave velocity independent of the ion mass. These waves are found at high electron densities in the frequency range between the electron cyclotron frequency and the geometric mean cyclotron frequency, and they are therefore more suitable for measurements on the plasma than the ordinary magnetohydrodynamic wave. It is shown that the resonance frequencies, which are characteristic for the conductivity or the elements of the conductivity tensor, generally appear as singularities in some dispersion relation and that these frequencies therefore are very difficult to observe without simultaneous excitation of other resonances. The solenoidal electric field applied to the plasma has its biggest advantage in the high-pressure and low-frequency ranges where the collision frequencies are larger than the driving frequencies. Measurements of the elements in the impedance tensor will then give the electron and ion collision frequencies as well as the average electron density. (auth)

18552 (AD-265113) STUDY OF ELECTROMAGNETIC INTERACTIONS IN PLASMAS. Quarterly Progress Report No. 6, April 1 to June 30, 1961. R. W. Gould and D. G. Dow (California Inst. of Tech., Pasadena. Electron Tube and Microwave Lab.). Contract DA36-039 Sc-85317. 21p.

The interaction of electron beams with infinite plasmas was studied theoretically, examining both the longitudinal and transverse waves. It is shown that even for arbitrary angle between the direction of propagation and the electron beam, the two wave types are approximately decoupled. Expressions and curves for the propagation constants and growth rates are given for several interesting special cases. Results of a preliminary experiment to study diffusion of a Cs plasma across a magnetic field suggest that electron loss is the determining factor in the loss rate. (auth)

18553 (AD-266081)' PROPAGATION IN TRANSVERSELY MAGNETIZED PLASMA BETWEEN TWO CONDUCTING PARALLEL PLANES. H. Unz (Ohio State Univ. Research Foundation. Antenna Lab., Columbus). Oct. 15, 1961. Contract AF33(616)-6782. 56p.

An operational calculus method for the solution of anisotropic media boundary-value problems is discussed. A six-by-six determinantal equation is found for the propagation constant. Transformation relations between transversely magnetized ferrites and plasma are given and the invariancy of the boundary conditions is pointed out. The propagation constant for the case of transversely magnetized ferrite or plasma is found for the rectangular waveguide in terms of two parameters which should be determined from the boundary conditions. The electromagnetic field in transversely magnetized ferrites between two perfectly conducting parallel planes is found and compared with existing solutions. Using the above transformation relations, the electromagnetic fields in transversely magnetized plasma between two perfectly conducting parallel planes is given in detail. It is shown that the TEno mode is also a rectangular waveguide mode for the plasma case. (auth)

18554 (AD-266196) AN OUTLINE OF THE BASIC EQUATIONS AND CONCEPTS OF PLASMA DYNAMICS. Report No. 5-49. W. C. Duesterhoeft and B. M. Fannin (Texas. Univ., Austin. Electrical Engineering Research Lab.). Sept. 30, 1961. Contract AF33(616)-6257. 166p.

The basic equations of plasma dynamics are developed from fundamental laws of electrodynamics and hydrodynamics. Some of the approximate forms of these basic equations are presented, along with an indication of the physical significance of the approximations made and the more important conclusions or concepts derived from their study. It is intended to give the novice a concise, consistent presentation of introductory concepts needed for more advanced work. Brief appendices covering the background topics of tensors, electromagnetic fields, and hydrodynamics are included. (auth)

18555 (AFCRL-735) THE COUPLING MECHANISMS BETWEEN LONGITUDINAL AND TRANSVERSAL WAVES IN A PLASMA. G. Burkhardt, Ch. Fahl, and R. W. Larenz (Hanover (City)). Technische Hochschule. Institut für Theoretische Physik). Jan. 3, 1961. Contract AF61(052)-161. 13p. (AD-268772)

The problem of coupling between longitudinal and transversal plasma waves is discussed. Starting from the basic plasma equations all possible coupling mechanisms were deduced in a general way. Besides the hitherto known mechanisms such as the effect of a pressure gradient, of an external magnetic field, and of a general flow of drift field, a nonlinear "internal coupling" effect which is able to generate electromagnetic radiation was found. The relativistic aspect of the problem is discussed also. (auth)

18556 (AFOSR-1546) THE EIKONAL METHOD IN MAGNETOHYDRODYNAMICS. Steven Weinberg (Advanced Research Projects Agency. Inst. for Defense Analyses, Washington, D. C.). Sept. 1961. Contracts AF49(638)-327 and Nonr-22260. 59p. (AD-266038)

The eikonal method is extended to waves with several components propagating in inhomogeneous anisotropic media. Formulas are derived for the motion of wave packets, the change in amplitude along a ray path, and the corrections due to diffraction. The method is applied to pure magnetohydrodynamic disturbances, and the problem of computing ray paths in the ionosphere is discussed. One result is that the fraction of the energy of an isotropic disturbance that eventually gets as low as 200 km drops from 0.99 at 200 km to 0.2 at 450 km, rises again to 0.99 at 700 km, drops to 0.5 at 3000 km and continues dropping at greater altitudes. Energy trapped between 200 km and 700 km oscillates around 450 km with period 8.5 sec (at the geomagnetic equator). The eikonal method is also applied to a very general problem involving coupled magnetohydrodynamic, electrodynamic, and acoustic modes. (auth)

18557 (PIBMRI-893-61) EXCITATION OF ACOUSTICAL WAVES IN A PLASMA. T. Morrone (Brooklyn. Polytechnic Inst. Microwave Research Inst.). June 19, 1961. Contract AF30(602)-2045. 27p. (RADC-TN-61-201; AD-266098)

The possibility of putting significant amounts of power into the acoustical wave by a suitable choice of parameters characterizing the plasma and the incident wave is investigated. They are plasma density, collision frequency, angle of incidence and electromagnetic wave frequency. The conclusion reached is that it is not possible under ordinary laboratory conditions to transfer significant power to the acoustical wave, and that in problems of propagation in a

plasma, acoustical wave considerations may be neglected with very little error. The conclusions are based on a small signal linear analysis, and are subject to the model of the plasma assumed, i.e., a neutral weakly ionized uniform plasma with electron, ion, and neutral temperatures equal except for small perturbations. The assumptions and development which lead to the dynamical equations used in the analysis are discussed, and a quantitative estimate is made of the region where the small signal analysis is valid. Above a certain power level the equations become nonlinear. (auth)

18558 (UCRL-9988) THEORY OF THE FULLY IONIZED PLASMA COLUMN WITH EXTERNAL PARTICLE PRODUCTION. [PART] I. Guenter Ecker (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 15, 1961. Contract W-7405-Eng-48. 21p.

There is considerable interest in the investigation of the plasma column with an external cylindrical particle source in the core of the column. Examples for such devices are the contact-ionized Cs plasma and the hollow cathode discharge. A theoretical investigation of a model composed as an infinite cylindrical vessel of diameter 2R lying in a longitudinal magnetic field (B) was conducted. A coaxial core of diameter 2r is considered which contains electrons and ions of equal temperature T_0, is excluded from the plasma volume. This core is the external source of particle production, which provides an electron and ion current of density Γ_0 flowing into the plasma volume. These electrons and ions enter the discharge at r_0 and diffuse across the magnetic field towards the insulated wall of the container (R), where they recombine. It is assumed that volume recombination and end effects are negligible. The effective mean free path of electron-ion collisions is small in comparison to 2R. Density and temperature distributions are calculated from a simultaneous solution of the transport equations for mass, momentum, and energy. In general the results cannot be presented in analytic form but must be determined by machine solutions. Particularly noteworthy is a strong temperature variation across the discharge vessel. This variation has a remarkable influence on the density distributions and makes Schottky's approach inapplicable. The density at the edge of the core is determined from the eigenvalue problem as a function of the experimental parameters B, Γ_0, T_0, and R. A similarity law is given. (auth)

18559 (FTD-TT-61-345) EJECTION OF PLASMA FROM AN ELECTRODELESS PULSE DISCHARGE IN A VACUUM. M. D. (G.) Gabovich and L. I. Romanyuk. Translated from Ukrain. Fiz. Zhur., 6: 461-7(1961). 10p.

An experimental study was carried out on plasma ejected from an electrodeless pulse discharge in a vacuum through a narrow channel dividing the two regions. The ejected plasma is characterized by a velocity of approximately 8×10^8 cm/sec, by an ionic flux density at the outlet of the channel of over 100 amp/cm^2, by an ion concentration at this spot of the order of 1×10^{14} cm^{-3}, and by periodic fluctuations of its potential. (M.C.G.)

18560 (FTD-TT-62-338) JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS (SELECTED ARTICLES). Translated from Zhur. Priklad. Mekhan. i Tekh. Fiz., No. 6, 3-7; 24-35; 54-68(1961). 53p.

A total of four papers are included for three of which separate abstracts were prepared. The paper which was not abstracted concerns deterioration of delta wings in hypersonic flow. (J.R.D.)

18561 (FTD-TT-62-338(p.1-9)) CONDITIONS OF THE EVOLUTION OF MAGNETOHYDRODYNAMIC FLOWS. R. V. Polovin. Translated from Zhur. Priklad. Mekhan. i Tekh. Fiz., No. 6, 3-7(1961).

The limitations imposed on various types of continuous magnetohydrodynamic (MHD) flows by evolution conditions are investigated. Conditions concerning the evolution of oblique MHD shock waves adjoining the streamline angle vertex are determined. (J.R.D.)

18562 (FTD-TT-62-338(p.10-18)) CONCERNING THE BEHAVIOR OF CERTAIN PLASMA STATES WITH ANISOTROPIC DISTRIBUTION OF VELOCITIES IN A MAGNETIC FIELD. G. M. Zaslavskii (Zaslavskiy) and S. S. Moiseev (Moiseyev). Translated from Zhur. Priklad. Mekhan. i Tekh. Fiz., No. 6, 24-8(1961).

The cyclotronic instability of anisotropic, relativistic plasma is examined. The anisotropy which develops as a result of electron radiation in magnetic fields when the radiation time is much less than the interval between collisions is also investigated. A discussion of electron distribution in the presence of cyclotron resonance is included. (J.R.D.)

18563 (FTD-TT-62-338(p.19-32)) THE OPERATION OF A PLASMATRON HAVING AN AIR-STABILIZED ARC. G. Yu. Dautov, M. F. Zhukov, and V. Ya. Smolyakov. Translated from Zhur. Priklad. Mekhan. i Tekh. Fiz., No. 6, 29-35(1961).

An analysis of conditions related to the stability of d-c arcs is presented. Experimental results are included obtained with an apparatus in which 6000°K was attained. The thermal efficiency in this plasmatron was about 50%. Vortex cooling and gas flow techniques were used to decrease electrode material expenditure to the point where decomposition products in the gas stream amounted to less than 1%. (J.R.D.)

18564 (UCRL-Trans-748) A HIGH INTENSITY INJECTOR OF HYDROGEN IONS. R. A. Demirkhanov, O. F. Poroshin, P. E. Belensov, and B. P. Mkheidze (Akademiya Nauk Ukr. S.S.S.R. Fiziko-Tekhnicheskii Institut). Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from a paper presented at the IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, September 1961. 10p.

A description of a high-intensity continuous operation injector of hydrogen ions is presented. A beam of hydrogen ions was obtained with a current of 275 ma and a relatively high coefficient value of beam directionality, R = 7 A/cm^2. Ion selection was carried out with a developed surface of the penetrating plasma with a suction voltage of 45 kv. A plasma-arc source was used. (M.C.G.)

18565 MAGNETIC AND ELECTRIC PRESSURE IN A CONFINED PLASMA. Richard L. Moore (Richard L. Moore Consultants, Los Angeles). J. Electronics and Control (1), 12: 13-21(Jan. 1962). (In English)

The usual hydromagnetic equations are applied to a fully ionized two-fluid bounded plasma with uniform temperature in a magnetic bottle. The condition of equilibrium is shown to imply a gaussian distribution of plasma density, and internal magnetic and electric fields, with non-zero charge density throughout the plasma. The equilibrium is forced by the reflection of electrons at the magnetic bottle surface. The guiding centers of the ions and electrons between collisions rotate about the axis of a cylindrical plasma under the combined action of the axial magnetic and the radial electron field. This condition must hold for a plasma which is to be treated as continuous regardless of collision frequency. These results are in direct opposition to the usual

assumptions of plasma charge neutrality, uniform density, and negligible electric fields. The force due to the combined action of the electric and magnetic fields, is shown to be irrotational conservative, and the negative gradient of a potential which is the magnetic energy of the plasma is treated as a perfect conductor with linear mass density. Although it is an equilibrium condition, a plasma of this configuration may not be stable. Both radial oscillations and interchange of angular momentum between the electrons and ions may lead to secular change. (auth)

18566 COMPARISON OF MICROWAVE AND LANGMUIR PROBE MEASUREMENTS ON A GASEOUS PLASMA. G. R. Nicoll and J. Basu (Manchester Coll. of Science and Tech., Eng.). J. Electronics and Control (1), 12: 23-9(Jan. 1962). (In English)

Microwave and Langmuir probe measurements were carried out simultaneously on the plasma of a low-pressure mercury-vapor arc. The values of the average electron density, obtained by the two types of measurements, are in reasonable agreement. The effect of the well-known Lorentz term in the evaluation of the electron density in low-density plasmas is discussed in the context of microwave measurements. The method of Hoyaux for obtaining the space potential from the voltage–current characteristic for the Langmuir probe is confirmed. (auth)

18567 EXPERIMENTAL ANALOGUE STUDY OF CONTAINMENT OF DENSE PLASMAS IN RESONANT-CAVITY FIELDS. Albert J. Hatch and J. W. Butler (Argonne National Lab., Ill.). J. Electronics and Control (1), 12: 89-103(Feb. 1962). (In English)

An analogue experiment was devised to study the conditions for the equilibrium of dense plasma cores contained by r-f cavity fields. Plasma cores are simulated by copper spheres, spheroids, and other configurations. Frequency shifts that result from finite perturbations in size, position, and configuration are measured. The measurements are interpreted by use of the Wien–Ehrenfest adiabatic theorem to yield information on equilibrium of the core. Measurements indicate that cores in a spherical cavity are in stable equilibrium against all three types of perturbation only in the magnetic quadrupole mode and in higher order magnetic multipole modes of the cavity fields. (auth)

18568 PLASMA OSCILLATIONS IN A MAGNETIC FIELD AS AN INITIAL VALUE PROBLEM. N. Anderson (Univ. of Hull, Eng.). J. Electronics and Control (1), 12: 119-24(Feb. 1962).

The oscillation of a plasma, composed of particles of a single type, in a static external magnetic field as an initial value problem is studied. An expression is obtained for the Laplace transform of the electric potential which arises due to the oscillation, and from this is derived the dispersion relation between the frequency of the oscillations and the wave number. For the particular case of propagation perpendicular to the magnetic field, the dispersion equation reduces to that given by Bernstein and that for the case of propagation along the magnetic field the waves are damped in time. If the phase velocity of the waves is considerably greater than the mean thermal velocity of the particles the damping is slight. (auth)

18569 HEAT TRANSFER FROM PARTIALLY IONIZED GASES IN THE PRESENCE OF AN AXIAL MAGNETIC FIELD. V. J. Raelson and P. J. Dickerman (Univ. of Chicago). J. Heat Transfer, 84: 169-76(May 1962).

This work was performed in order to investigate the influence of an axial magnetic field on the flow properties and heat-transfer characteristics of a partially ionized gas in a cylindrical flow channel. A description of the plasma generator and test channel is given along with experimental results for heat-transfer measurements at the channel wall and flow conditions within the channel as a function of field strength. Data obtained show a heat-flux reduction to the walls of the order of 20% for a field strength of 20 kilogauss with indications that the interaction is limited to the boundary-layer region. (auth)

18570 THE EFFECTS OF HALL AND ION SLIP ON THE ELECTRICAL CONDUCTIVITY OF PARTIALLY IONIZED GASES FOR MAGNETOHYDRODYNAMIC RE-ENTRY VEHICLE APPLICATION. M. J. Brunner (General Electric Co., Philadelphia). J. Heat Transfer, 84: 177-84(May 1962).

The presence of a partially ionized gas around a hypersonic vehicle permits the application of magnetohydrodynamic (MHD) devices during re-entry. The operation of such MHD devices on a re-entry vehicle will largely depend on the magnitude of the electrical conductivity of the gas between the electrodes. In some cases it may be necessary to seed the air in order to insure high conductivity. The operation of the re-entry vehicle at relatively low gas densities and high magnetic fields will produce Hall and ion slip effects which may materially reduce the effective conductivity between the electrodes. The electrical conductivity including Hall and ion slip effects for air is presented for a wide range of pressures and temperatures and for a typical re-entry vehicle, with and without seeding. The electrical conductivity is evaluated for equilibrium conditions considering the number density and collision cross sections for electrons, neutrals, and ions. The Hall and ion slip effects are evaluated from the degree of ionization, the cyclotron frequency, and the time between collisions for electrons, neutrals, and ions. (auth)

18571 SCATTERING LOSS FROM MAGNETIC MIRROR SYSTEMS. [PART] II. D. J. BenDaniel and W. P. Allis (Massachusetts Inst. of Tech., Cambridge). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 79-88(Apr. 1962). (In English)

The "reference distribution" method for scattering loss from a magnetic mirror system was developed, and the "square well" approximation was considered (D. J. BenDaniel and W. P. Allis, J. Nuclear Energy, Pt. C, 4: 29 (1962)). Results are presented of a study in which the "square well" treatment was generalized by the reference distribution method to a class of more realistic mirror machine shapes. It is shown that the rate of change of density and energy in those systems may be considered in terms of equations similar in form to those derived from the "square well." Graphs are presented of the results of numerical calculations in which the independent parameter was the "shape" of the system. (auth)

18572 STABILITY OF TUBULAR PINCH OF SMALL PRESSURE. A. Andreewsky and M. Trocheris (Euratom-CEA, Fontenay-aux-Roses, France). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 95-101(Apr. 1962). (In French)

The hydromagnetic stability of a tubular pinch is studied in the limit of a small kinetic pressure and a strong magnetic field. A sufficient condition for stability is found in the form of an upper bound on the components of the current density and their derivatives with respect to the radial coordinate. This was obtained in a search for a rigorous justification of the expansions used to study hydromagnetic stability for small kinetic pressures. (auth)

18573 WAVE PROPAGATION IN A PARTIALLY IONIZED MEDIUM. Annie Baglin. J. phys. radium, 22: 811-20(Dec. 1961). (In French)

The propagation and damping of low-frequency waves are studied in an infinite uniform, partially ionized medium in a longitudinal magnetic field. Two longitudinal modes and two transversal uncoupled modes are obtained. One of the transversal modes corresponds to the acoustic wave, and the other is rapidly damped. The two transversal modes have speeds which are very close to the speed of Alfven waves (obtained in the case of a fully ionized medium). These waves are damped by collision between particles and the coefficient is proportional to the square of the frequency. (auth)

18574 ON THE MOTION OF A CYLINDRICAL PLASMA-LAYER. Keishiro Nio (Tokyo Univ.). J. Phys. Soc. Japan, 17: 681-5(Apr. 1962). (In English)

The motion of a cylindrical plasma layer caused by a magnetic field induced by currents flowing through the plasma is investigated using the two-fluid model. The motions of electron and ion layers are considered individually. The phenomena are classified into two types; in one, the electron layer driven by the Lorentz force to the center axis of the cylinder is separated rapidly from the ion layer, and a wide space with the electric field is formed between the two layers. In the other, the electron layer oscillates about the ion layer that is driven slowly to the axis of symmetry. Numerical calculations are performed for typical examples. (auth)

18575 STATISTICAL LINE BROADENING IN PLASMAS. H. K. Wimmel (Yale Univ., New Haven). J. Quant. Spectroscopy Radiative Transfer, 1: 1-29(Sept. 1961).

Fundamental questions encountered in theories of line broadening are discussed. Approximations made in more compact and practical approaches to the subject are considered. Only the statistical type of line broadening theory is studied. Conditions under which ion broadening of spectral lines emitted from neutral atoms in plasmas can be described by the statistical theory are investigated by studying the fluctuations of the electric microfield acting on a radiating atom. Classical paths and absence of interaction between perturbers are assumed. The Fourier-integral formula for the line shape reveals effects that cause deviations from the statistical line shape. Two of them, diabaticity and radiator rotation, are negligible compared to the third, whenever the total deviations are sufficiently small. The third effect, which may be called a phase-shift effect, arises from the frequency modulation in time and the loss of phase coherence occurring in a characteristic time $T_\phi(F)$, the latter being related to the mean life-time $T_F(F)$ of a given electric microfield F. The correlation function of the spectrum is written as a double ensemble average: an ensemble average is taken over the frequency shift as a function of time for $t \neq 0$, with the initial frequency shift at $t = 0$ held fixed; subsequently, the expression obtained is averaged over all possible initial frequency shifts. On representing the correlation function by a Taylor expansion in time, an expansion for the line shape is obtained that satisfies the wing theorem and reduces to Holtsmark's line shape for high densities and low temperatures. The first-order correction to the statistical line shape is evaluated numerically; it vanishes near the maximum of the Holtsmark line shape (reduced field-strength $\beta = 1.6$), while the maximal deviations occur in the ranges $\beta \approx 1$ and $\beta \approx 3$, the over-all effect being an intensity shift toward larger values of β. The average absolute magnitude of the correction reaches 38 and 16% for the lines H_β and H_γ at $T = 10^4$°K and $n_{ion} = 10^{17}$ cm^{-3} at $0.5 \leq \beta \leq 10$; however, diabaticity and radiator rotation are not negligible and may alter the magnitude of the correction. (auth)

18576 FORBIDDEN HELIUM LINE IN A PLASMA SPECTRUM. H. Sadjian (General Electric Co., Philadelphia), H. K. Wimmel, and H. Margenau. J. Quant. Spectroscopy Radiative Transfer, 1: 46-52(Sept. 1961).

The appearance of forbidden spectral lines in a plasma yields a means of determining the plasma ion density by measuring relative intensities or frequency shifts. A simple static analysis is applied to the He I lines 4^1D-2^1P yields an ion density of 5×10^{16} cm^{-3}, in agreement with other evidence. (auth)

18577 EQUILIBRIUM EMISSIVITY CALCULATIONS FOR A HYDROGEN PLASMA AT TEMPERATURES UP TO 10,000°K. D. B. Olfe (California Inst. of Tech., Pasadena). J. Quant. Spectroscopy Radiative Transfer, 1: 104-34 (Nov. 1961).

Equilibrium emission processes in a hydrogen plasma were investigated at 300 to 10,000°K up to several hundred atmospheres pressure. Representative emissivity calculations were carried out for a transparent gas. For a non-transparent gas, the case of a total pressure of 100 atm. and a mean beam length of 30 cm was considered. Important emissivity contributions are made by the pressure-induced fundamental vibration-rotation band and rotational lines of H_2 below approximately 4500°K. Above this temperature, the bound-free and free-free transitions of the H^- ion and the continuum and line radiation of the H atom are the most important contributors to the emissivity. The following emission processes were investigated: the bound-free transitions of the H_2^+ ion, free-free transitions of colliding H atoms and H^+ ions, electronic transitions of the H_2 molecule, quadrupole vibration-rotation transitions of the H_2 molecule, and vibration-rotation transitions of the HD molecule. Effects of the lowering of the ionization potentials by the fields of plasma ions and of the very broad wings of the Lyman α-line were considered. (auth)

18578 PINCHED LIGHTNING. B. T. Matthias and S. J. Buchsbaum (Bell Telephone Labs., Inc., Murray Hill, N. J.). Nature, 194: 327(Apr. 28, 1962).

A photograph is presented showing a pinched natural lightning discharge having a transverse dimension of about 1 to 5 m. (T.F.H.)

18579 INSTABILITY IN LOW-PRESSURE PLASMA DIFFUSION EXPERIMENTS. Gareth Guest (North Texas State Univ., Denton) and Albert Simon. Phys. Fluids, 5: 503-9(May 1962). (GA-2671)

The stability of a weakly ionized, low-density (10^{10}-10^{12}) plasma in a uniform magnetic field is considered. The plasma is in a finite conducting chamber, and there is diffusion across the field lines and streaming to the conducting end walls. Instability appears above a critical field or below a critical background pressure. The driving force is the charge separation produced by the unequal streaming of ions and electrons to the end walls. The unstable mode is helical in space and rotates about the axis of symmetry. Expressions are obtained for the critical field value and for the rotational velocity. (auth)

18580 STABILITY CRITERION FOR ARBITRARY HYDROMAGNETIC EQUILIBRIA. John M. Greene and John L. Johnson (Princeton Univ., N. J.). Phys. Fluids, 5: 510-17 (May 1962). (MATT-109)

A necessary and sufficient condition for stability with respect to localized displacements is obtained for arbitrary bounded hydromagnetic equilibria. The use of a natural coordinate system containing important properties of the equilibrium configuration facilitates understanding of the instability. (auth)

18581 HIGH-FREQUENCY CONDUCTIVITY AND THE EMISSION AND ABSORPTION COEFFICIENTS OF A FULLY IONIZED PLASMA. John Dawson and Carl Oberman (Princeton Univ., N. J.). Phys. Fluids, 5: 517-24(May 1962). (MATT-101)

The problem of the a-c conductivity of a fully-ionized plasma is investigated for frequencies embracing the plasma frequency. The finite duration of encounters is considered in a self-consistent fashion which includes collective effects. The concomitant processes of absorption and emission of electromagnetic radiation are investigated, and bremsstrahlung emission and absorption coefficients near the plasma frequency are given. The conversion of longitudinal to transverse waves by scattering from ions is discussed. (auth)

18582 KINETIC EQUATIONS FOR A PLASMA. Ram K. Varma (Tata Inst. of Fundamental Research, Bombay). Phys. Fluids, 5: 525-33(May 1962).

Starting with Liouville's equation, equations are derived in the random-phase approximation for the evolution of the spatial Fourier components of the complete distribution function of a particle in a plasma. A procedure is used which takes account of all the contributions coming from many-body interactions in the random-phase approximation. The equations describe the collective part of the response of plasma to the particle. Those that have the structure of the Fokker-Planck equation describe collisions of electrons carrying an envelope of plasma waves emitted by them. In the Markoff approximation, this envelope degenerates into a Debye shielding cloud, so that the equations describe the collisions of electrons clothed in Debye shielding clouds. (auth)

18583 ELECTROSTATIC OSCILLATIONS NEAR THE ION CYCLOTRON FREQUENCY. N. D'Angelo and R. W. Motley (Princeton Univ., N. J.). Phys. Fluids, 5: 633-4 (May 1962). (MATT-107)

Measurements of ion wave instabilities in plasma in which the electron drift velocity is a few % of the electron thermal speed and ion and electron temperatures are about equal are reported. Experiments were performed in Cs and K plasmas 3 cm in diameter and about 60 cm long produced by surface ionization of atoms on a hot tungsten plate. If sufficient positive voltage is applied to the collector to raise the electron drift velocity to about 10 times the ion thermal velocity, oscillations appear in the collector current. Results agree with theory. (L.N.N.)

18584 CURRENT-INDUCED EFFECTS IN AN ALKALI-METAL PLASMA. Nathan Rynn (Princeton Univ., N. J.). Phys. Fluids, 5: 634-6(May 1962).

The plasma is formed between two hot tungsten plates by directing an atomic beam of Cs or K against one of them. It is confined radially by an external magnetic field. A potential is applied, and the current through the plasma is measured. Oscillations and density were investigated, and data are presented in graphical form. Results are similar for K and Cs. (L.N.N.)

18585 ROTATION OF PLASMAS IN Θ PINCHES. George Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Fluids, 5: 636(May 1962).

It is shown that plasma can acquire angular momentum through more processes if the unnecessary restriction of the constancy of kinetic angular momentum (N. Rostoker and A. C. Kolb, Phys. Rev., 124: 965(1961)) is lifted. (L.N.N.)

18586 ENERGY LOSS OF A FAST ION IN A PLASMA. S. T. Butler and M. J. Buckingham (Univ. of Sydney). Phys. Rev., 126: 1-4(Apr. 1, 1962).

The problem is considered of a fast charged particle injected into a plasma at an energy in excess of plasma thermal energies. Closed expressions are obtained for the behavior of the mean energy as a function of time, and also for the diffusion spread around this mean. An expression is given for the characteristic speed (u) of any plasma, defined such that for all test particle speeds in excess of u energy is lost predominantly to electrons, while the loss goes to the positive ions for speeds less than u. For fully ionized deuterium gas, u is $1/14$ of the electron thermal speed; if the electron and ion temperatures are the same, u is only 4 times the ion thermal speed. (auth)

18587 RADIATION IN A PLASMA. II. EQUIVALENT SOURCES. Marshall H. Cohen (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 126: 389-97(Apr. 15, 1962).

The fields in a plasma are postulated to satisfy the linearized plasma equations containing electric and acoustic source terms. The fields and discontinuities produced by surface layers of the sources are discussed. It is shown that the fields in a homogeneous source-free volume (V) are given uniquely by their values in V at time zero, plus boundary values for $t > 0$, either $n \times E$ or $n \times H$, and either n_1 or $n \cdot v$. The fields in the volume are the same as those radiated by a certain set of equivalent surface sources on the boundary. Integral equations for the scattering by a plasma bubble are derived. The differential scattering cross sections are evaluated for a small bubble, by using the Born approximation. (auth)

18588 RADIATION IN A PLASMA. III. METAL BOUNDARIES. Marshall H. Cohen (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 126: 398-404(Apr. 15, 1962).

The reflection of a plane wave in a plasma at a metal boundary is discussed using the linear continuum theory. A positive sheath is the consequence of requiring the net current flow into the boundary to be zero. The dipole antenna in a plasma is considered from the scattering point of view. Integral equations for the dipole fields are derived. The fields and radiation resistances for a short linear current filament are given. (auth)

18589 ENERGY LOSSES OF CHARGED PARTICLES IN A PLASMA. V. N. Tsytovich (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 803-11(Mar. 1962). (In Russian)

The differential probabilities for radiation and absorption of longitudinal and transverse quanta by a charged particle in media with space dispersion are determined in the presence of radiation. It is shown that in a quantum analysis which takes into account the recoil effect, the energy losses depend on the radiation density. Energy losses of relativistic particles in high-temperature and ultrarelativistic plasmas are considered. (auth)

18590 ON ONE-DIMENSIONAL AUTOMODEL WAVES MOVING IN A PLASMA ALONG A MAGNETIC FIELD. B. A. Tverskoi (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 833-8(Mar. 1962). (In Russian)

A one-dimensional steady-state pulse moving along a magnetic field in a cold plasma is considered. The calculations are performed in the nonrelativistic single-particle approximation ignoring collisions, the plasma being assumed quasi-neutral. An exact solution of the corresponding equation set is presented. The shape of the pulse and velocity distribution are investigated. The magnetic field force lines and trajectories of the pulse particles are found to be spirals. The dependence of the Mach number on the wave energy is determined. It is shown that even small oscillations of the magnetic field cause an appreciable acceleration of the electron component of the pulse at its

maximum. Most of the wave energy in this case is concentrated in the kinetic energy of the electrons. (auth)

18591 ONE-PARTICLE EXCITATIONS IN A NON-DEGENERATE ELECTRON GAS. E. K. Kudinov and S. T. Pavlov (Inst. of Semiconductors, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 839-45(Mar. 1962). (In Russian)

The one-particle Green's function for a non-degenerate electron gas is calculated in the Born approximation. It is shown that if Coulomb interaction is taken into account, single-particle excitations (plane waves) are distorted as a result of damping as well as of time modulation of the unperturbed wave. (auth)

Shielding

18592 (HW-73255) SHIELDING PROPERTIES OF IRON SERPENTINE CONCRETE. E. G. Peterson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 4, 1962. Contract [AT(45-1)-1350]. 26p.

The effects of high temperature on neutron and gamma attenuation in iron serpentine concrete were studied. Results are given in graphs and tables. (M.C.G.)

18593 (TIM-80) COOLING OF LEAD SHIELDS. L. E. Anderson (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Nov. 19, 1954. Contract [AT(11-1 -229]. 23p.

An investigation was conducted to find a suitable coolant for two concentric, spherical lead shells used as shields for a source of gamma rays and neutrons located in a sphere. Another objective of the investigation was to determine the flow rate which is adequate to cool the shield without an excessive amount of power. Water and benzene were compared for use as coolant. Results are presented tabularly. It is concluded that water is the more desirable cooling fluid except from the weight standpoint. (J.R.D.)

Theoretical Physics

18594 (CERN-62-13) SPECULATIONS ON EXPERIMENTAL CONSEQUENCES OF REGGE POLES. W. Kummer (European Organization for Nuclear Research, Geneva). Mar. 13, 1962. 26p.

Theoretical background information is presented concerning the existence of poles (Regge poles) found in a large class of potentials. It is noted that only a general introduction to the whole problem is given. References are included as a source for further details. (J.R.D.)

18595 (NYO-10129) DYNAMICAL MAPPINGS OF DENSITY OPERATORS IN QUANTUM MECHANICS II: TIME DEPENDENT MAPPINGS. Thomas F. Jordan, Mark A. Pinsky, and E. C. G. Sudarshan (Rochester, N. Y. Univ.). Mar. 1, 1962. Contract AT(30-1)-875. 15p.

The most general continuous time dependent evolution of a physical system is represented by a continuous one-parameter semi-group of linear mappings of density operators to density operators. It is shown that if these dynamical mappings form a group they can be represented by a group of unitary operators on the Hilbert space of state vectors. This proof does not assume that the absolute values of inner products of state vectors or transition probabilities are preserved but deduces this fact from the requirement that density operators are mapped linearly to density operators. An example is given of a continuous one-parameter semi-group of dynamical mappings which is not a group. (auth)

18596 COORDINATE COVARIANCE AND THE PARTICLE SPECTRUM. D. W. Joseph (Purdue Univ., Lafayette, Ind.). Phys. Rev., 126: 319-23(Apr. 1, 1962).

An attempt is made to find an analog, for the quantum mechanics of non-Euclidean space-time, to the classification of representations of the Lorentz group. The difficulty of obtaining any such classification in terms of curvilinear coordinates is pointed out, and the use of a higher-dimensional set of pseudo-Euclidean coordinates is chosen as an alternative mode of classification. A class of representations then follow easily. On the basis of an intuitive approximation it is found that spectra of elementary particles, with conservation of quantities of the nature of isotopic spin, seem to arise from these representations. (auth)

18597 MULTIPLE PRODUCTION OF PHOTONS IN QUANTUM ELECTRODYNAMICS. Kalyana T. Mahanthappa (Harvard Univ., Cambridge, Mass.). Phys. Rev., 126: 329-40(Apr. 1, 1962).

A formalism intended to evaluate the expectation value of physical quantities directly is applied to processes involving multiple production of photons in quantum electrodynamics. This application is achieved by constructing the Green's function, which is accomplished by expanding it in terms of hard and soft photon parts of the electromagnetic field. A general treatment of infrared divergence is given. The cross section for $\underline{n}$-photon production in Coulomb scattering and pair annihilation is evaluated. The limitation of the expansion of the Green's function in terms of hard and soft photon parts is examined. A plausible generalization regarding the cross section of any primary process in quantum electrodynamics at high energies with $\underline{n}$-photon emission in the final state is enunciated. (auth)

18598 BINARY COLLISION EXPANSION OF THE CLASSICAL N-BODY GREEN'S FUNCTION. Jerome Weinstock (National Bureau of Standards, Washington, D. C.). Phys. Rev., 126: 341-4(Apr. 1, 1962).

The explicit time integrations in the formal binary collison expansion of the classical $\underline{N}$-body Green's function are performed, to obtain a product of binary collision operators. These integrations are exact for hard-sphere interactions and are expected to be a good approximation for finite but short-range pair interactions. The resulting expansion can be averaged over configuration space to obtain a transport equation for a dense gas in analogy with the cluster expansion of the classical partition function. (auth)

18599 INDETERMINATE CHARACTER OF THE REDUCTION OF THE WAVE PACKET IN QUANTUM THEORY. Arthur Komar (Syracuse Univ., N. Y.). Phys. Rev., 126: 365-9(Apr. 1, 1962).

Von Neumann's proof of the ineffectiveness of the use of hidden variables to account for the reduction of the wave packet is analyzed. A possible weakness of the argument is found in the manner in which the probabilistic interpretation of quantum theory is employed. An alternative proof is presented which avoids this aspect of quantum theory. The conclusion is drawn that there is no theory consistent with quantum mechanics which can account for the occurrence of events in nature. (auth)

18600 QUANTIZATION AND THE CLASSICAL HAMILTON-JACOBI EQUATION. Lloyd Motz (Columbia Univ., New York). Phys. Rev., 126: 378-82(Apr. 1, 1962).

A formalism for quantization is developed starting from the Hamilton-Jacobi expression, $\partial S/\partial t + H(\partial S/\partial q, q)$, and leading to its quantum-mechanical operator equivalent by

means of straightforward algebra. The quantum-mechanical operator equivalents of H and p are then seen to be the consequence of assigning a number of equally probable classical paths to a dynamical system. (auth)

18601 EXCHANGE INTERACTION AND HEISENBERG'S SPIN HAMILTONIAN. Tadashi Arai (Argonne National Lab., Ill.). Phys. Rev., 126: 471-88(Apr. 15, 1962).

By the use of representation matrices U (P) of the permutation group, the energy matrix of many-electron systems is expanded such that $E = \Sigma_P J_P \tilde{U}$ (P), and it is proved that all the coefficients J_P are bounded and determined uniquely. This means that the expansion is mathematically valid even though nonorthogonal orbitals are used and no matter how large the overlaps between the orbitals are. Furthermore, it is shown that the nonorthogonality catastrophe pointed out by Inglis and Slater does not appear, and that values of the coefficients can be evaluated correctly even if higher permutations are omitted. The Heisenberg spin operator is found as the first-order approximation of the expansion. (auth)

18602 LINDE'S LAW AND THE SCATTERING POWER OF ASSOCIATED POINT DEFECTS. C. P. Flynn (Univ. of Illinois, Urbana). Phys. Rev., 126: 533-7(Apr. 15, 1962).

Resistivity data on dilute alloys indicate that the scattering power of a point defect is relatively unaffected by the proximity of other defects. The scattering power of defect pairs as a function of separation is therefore investigated as a two-center scattering problem, and the theory is found to predict the observed insensitivity of scattering cross section to defect separation for all realizable separations of the defects. (auth)

18603 BEHAVIOR OF SCATTERING AMPLITUDES AT HIGH ENERGIES, BOUND STATES, AND RESONANCES. R. Blankenbecler and M. L. Goldberger (Princeton Univ., N. J.). Phys. Rev., 126: 766-86(Apr. 15, 1962).

An exact Fourier-Bessel representation of the scattering amplitude is introduced and discussed for potential scattering and field theory. It is shown to contain the Mandelstam representation as a special case. The representation automatically satisfies unitarity exactly in the high-energy limit, even in the many-channel situation. The behavior of the scattering amplitude for large momentum transfers is discussed and it is demonstrated that this limit is directly connected with the formation of bound states and resonances. A selection rule governing the ordering of resonances is derived. A variational principle for calculating the asymptotic dependence on momentum transfer in potential scattering is formulated. Some relations between the asymptotic behaviors of π-π, π-N, and N-N are developed, and related to the single-particle poles and low-energy resonances. (auth)

18604 ANALYSIS OF MULTICHANNEL REACTIONS. Gordon L. Shaw (Univ. of California, San Diego and La Jolla) and Marc H. Ross. Phys. Rev., 126: 806-13(Apr. 15, 1962).

A method for analysis of multichannel reaction data is presented. A system of n strongly coupled two-body channels is considered, in a particular "partial wave." The energy dependence of the cross sections is treated in the effective range approximation; the corrections to the scattering amplitudes arising from mass differences between isotopic spin multiplets and Coulomb scattering are included. "Uncoupled" amplitudes which would describe the scattering in the absence of influences of one of the channels, are introduced. Relations between these uncoupled phases and the actual amplitudes are derived (in a nonperturbative manner). The use of the uncoupled phase procedure, in conjunction with an effective-range analysis, to test certain theories of strong interactions is discussed. (auth)

18605 REMARKS ON THE RELATIVISTIC KEPLER PROBLEM. L. C. Biedenharn (Duke Univ., Durham, N. C.). Phys. Rev., 126: 845-51(Apr. 15, 1962).

The Dirac-Coulomb (D-C) spherical wave functions are treated in a manner that brings out the close formal similarity between these solutions and the spherical wave solutions for the free-electron problem. The radial functions in the (D-C) representation have the same form as the nonrelativistic radial Coulomb functions, but with an irrational orbital "angular momentum." This representation is utilized to deduce a general recursion relation for radial Coulomb eigenfunctions, and to show the existence of the Coulomb helicity operator as a constant of the motion. The properties of this formulation are discussed. (auth)

18606 UNITARITY CONDITION AND ANOMALOUS VERTEX FUNCTIONS. K. Nishijima (Univ. of Illinois, Urbana). Phys. Rev., 126: 852-60(Apr. 15, 1962).

An intuitive method is given in perturbation theory for the calculation of the absorptive part of a vertex function in the anomalous region, starting from the unitarity condition. (auth)

18607 RADIATION OF GRAVITATIONAL WAVES BY ELEMENTARY PARTICLES. K. P. Stanyukovich. Vestnik Moskov. Univ., Ser. III, No. 5, 71-82(Sept.-Oct. 1961). (In Russian)

Gravitational waves emitted by nucleons are studied by postulating that the waves appear as a result of meson cloud rotation near the nuclear core. The radiation is of quadrupole type. Calculations are made of the energy carried away by the waves, and it is assumed that they explain the gravitational field of particles. The core dimensions ($r_0^3 \approx 10^{-4}$ cm) and the frequency of the meson cloud pulsation ($\omega_0 \approx 10^{24}$ sec^{-1}) are found. (tr-auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 18152, 18154, 18155, 18157, and 18421.

18608 (AERE-M-911) CALCULATION OF THE TEMPERATURE COEFFICIENT OF REACTIVITY OF A GRAPHITE-MODERATED REACTOR. G. Brown, R. Richmond, and R. H. W. Stace (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 6p.

Declassified version of NPCC/RPWP/P 66; AERE/R/M-132.

The temperature coefficients of reactivity of the BEPO, Windscale, and Calder reactors are calculated. The results are compared with experimental values. (auth)

18609 (AERE-M-1020) A REVISION OF THERMAL REACTOR CORE CALCULATIONS. C. G. Campbell and J. L. Symonds (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 18p.

Declassified version of NPCC/RPWP/P 60, 1957.

A method for performing core calculations for graphite moderated reactors is presented. (auth)

18610 (ANL-6544) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1962. (Argonne National Lab., Ill.). Apr. 15, 1962. Contract W-31-109-eng-38. 63p.

Developmental work is reported on the EBWR and Borax-V other general development work is reported in the area of liquid metal cooled reactors and particularly on the EBR-I and II, and the fast reactor test facility. General reactor technological development is described on applied reactor physics, reactor fuels development, reactor materials development, heat engineering and fluid flow, chemical separations, advanced systems, and nuclear safety. (J.R.D.)

18611 (BNL-713) THE SETTLED BED FAST REACTOR STATUS REPORT. Arnold Aronson, Leon Green, Loranus P. Hatch, Kenneth C. Hoffman, Melvin Levine, James McNicholas, Guyon Pancer, and William A. Robba (Brookhaven National Lab., Upton, N. Y.). Jan. 20, 1962. Contract [AT(30-2)-GEN-16]. 109p.

A status report is presented concerning the development of fast reactor systems utilizing fuel in the form of particulate solids cooled by direct flow of Na through a settled bed of such fuel. The emphasis in the investigation is on the reactor and its internals since this is the area that settled bed reactors differ from Na-cooled solid fuel reactors. Research and development is reported on the carbide fuel program, mechanical design, heat transfer and fluid dynamics, stability reactor physics, and economics. Characteristics of the reactor are presented tabularly. (J.R.D.)

18612 (DC-59-7-700) REACTIVITY MEASUREMENTS DURING PHASE II TESTS WITH THE HOTCE REACTOR. R. M. Kinkaid, J. K. Kunze, and K. J. Skow (General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho). July 1, 1959. Contract AT(11-1)-171. 14p.

The results of reactivity measurements made with the HOTCE reactor during phase II tests are given along with the significant test procedures that evolved during the experimentation. The reactivities corresponding to the asymptotic periods were determined from the in-hour relation. The worth of each test rod relative to the boron test rod was computed. (M.C.G.)

18613 (EURAEC-22) THE USE OF PLUTONIUM AS FUEL IN NUCLEAR REACTORS. Quarterly Report No. 1, July 15 to October 15, 1960. (Société Belge pour l'Industrie Nucléaire, Brussels and Brussels. Centre d'Étude de l'Energie Nucléaire). Work performed under United States–Euratom Joint Research and Development Program. Contract 027-60-7RDB. 83p.

Apparatus was constructed for the studies of precipitates formed with nitrates of calcinable salts and for recycling and analysis. This apparatus was tested with U. Two methods for the densification of UO_2 powders being examined are arc fusion and resistance fusion. Fabrication of spherical particles of UO_2 by mixture with a solution of camphor or alcohol in water and then screening was carried out. Simultaneous studies are being carried out on methods of compacting UO_2 and PuO_2 by vibration and swaging. Co-reduction and fusion of Nb–Zr alloys were studied. Efforts to make powders from these alloys proved successful. The co-reduction of UO_2–MoO_3 with carbon was carried out in an attempt to fabricate non-pyrophoric, γ-uranium. The following procedure was adopted for dispersion shaping: mixing the dispersed and dispersing phases, compression of the mixture, and swaging the pellet after it is sheathed. An apparatus was constructed which will allow measurement of the specific heat of ceramic fuels based on the heat content per unit/mass. A study of the reaction $Zr(\beta) \rightarrow Zr(\alpha) + Zr(\beta)$ was carried out at 380 to 600°C. Corrosion of Zr–Nb alloys was investigated to 300°C. The mechanical properties of scattered fuel elements were investigated. (M.C.G.)

18614 (EURAEC-96) IMPROVEMENT OF HEAT TRANSFER IN BOILING WATER REACTORS. Quarterly Report No. 4, January–March 1961. (Société Nationale d'Étude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). Apr. 26, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract [017-60-4RDF]. 30p.

Measurements of pressure and vacuum fraction losses in two-stage flows were continued. The assembly and experimental methods for use in water–steam separation were tested. Thermal tests were developed to assess the critical burnout fluxes in water and freon. (J.R.D.)

18615 (EURAEC-158) RESEARCH PROGRAMME ON HEAT TRANSFER IN A BOILING WATER REACTOR. Quarterly Progress Report No. 2, April, May, June 1961. (Eindhoven, Netherlands. Technische Hogeschool). Work performed under United States–Euratom Joint Research and Development Program. 10p.

The development of measuring methods for determining variables such as void fraction, power, pressure, circulation rate, and temperature under non-steady conditions in a boiling water circuit is still under way. The capacitance gage for measuring the void fraction was further improved by using an outer electrode consisting of four small plates instead of one of cylindrical form. A pressure gage for measuring differential pressures up to 25 cm water head with line pressures of 30 atmospheres was constructed

using also the capacitance method. Experiments were carried out with a model of the first core loading of the Halden reactor measuring the void fraction and circulation rate as a function of power and pressure up to 30 atmospheres and a heat flux of 1200 kw/m^2. In several conditions large variations in the pressure signal were present with a frequency of about 0.8 Hz and an amplitude of ±50 cm water head. Under normal conditions the boiling noise frequencies as measured with a fast pressure gage had an upper limit for this model of about 10 Hz with amplitudes of about 8 cm water head. During the experiments a burnout of the heating element occurred at a heat flux of 1200 kw/m^2 at 110°C. The results will be further analyzed in the next quarterly report. (auth)

18616 (EURAEC-191) STATISTICAL METHODS FOR HOT CHANNEL AND HOT SPOT CALCULATION. Quarterly Progress Report No. 3, July 1, 1961 to September 30, 1961. (FIAT. Sezione Energia Nucleare, Turin). Oct. 31, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 035-60-11RDI. 35p. (FN-E-12)

A model was developed to take into account the statistical deviations of design parameters from their nominal value. In this model, the reactor core (or a channel of it) is divided in a certain number of small regions ("spots"); in each of them every independent design parameter such as fuel density and enrichment and geometric dimensions being characterized by a fixed statistical distribution around the nominal value. A condition was introduced in which every parameter in a certain region is statistically independent from the values of all other parameters in all other core (or channel) regions. Owing to the simplicity of this model, it will be applied to the determination of the probability function of all the dependent variable interesting a nuclear-thermal-hydraulic core design. Formula were set up, using a linearization procedure, for the distribution and probability function of parameters such as enthalpy and bulk temperature, quality and void fraction, points of inception of local and bulk boiling, and various partial pressure drops in heating, local and bulk boiling regimes. From a statistical intersection of the total pressure drop curve versus total mass flow rate in the core with the entire system pressure drop-flow characteristic curve, the distribution of the mass rate of flow and pressure drops in every channels could be found. An analytical procedure is being developed which can be use to find the probability functions of "maximum" type parameters (for example: maximum surface temperature, maximum meat centerline temperature, maximum heat velocity or "burnout" flux). (auth)

18617 (EXP-NRX-70103) COOLED ORGANIC INSULANT TEST; EXPERIMENTAL DATA REPORT. H. E. Thexton (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Jan. 1962. 42p. (AECL-1455).

A proposed method of insulating hot coolant tubes from the moderator in an organic cooled reactor is to use a thin organic insulating annulus. A preliminary in-reactor experiment is reported in which a water cooled thimble was insulated from the hot organic in the test section of the X-7 loop in NRX. Approximate measurements of the heat-transfer coefficient across the annulus were made during the test and the annulus was sectioned and examined following the irradiation. The total integrated flux seen by the annulus during the two months irradiation was approximately 1.37×10^{20} n/cm^2 (nV_0t). The average bulk organic temperature was approximately 550°F. This resulted in little or no fouling in the annulus and no significant rise in the over-all heat transfer coefficient across the annulus. Details of the operating conditions of the experiment and of the post-irradiation examination, including photographs taken in the cell are presented. (auth)

18618 (NDA-2132-2) A STUDY OF WET STEAM AS A REACTOR COOLANT. Quarterly Technical Progress Report No. 1, October 1, 1959 through December 31, 1959. (Nuclear Development Corp. of America. White Plains, N. Y.). Jan. 30, 1960. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2303. 73p. (EURAEC-100)

Reactor conceptual designs of fog-cooled, water-moderated reactors are presented. The effects of variables such as burnout, pressure, mass velocity, and steam quality are discussed; they serve as a basis for guiding a series of heat transfer and fluid dynamics tests. The results of a brief study of the phenomenon of burnout as it applies to wet steam as a reactor coolant are presented. A reactivity formulation for use in this project is also presented. (auth)

18619 (NP-11490) MOLEKULARAKUSTISCHE UNTERSUCHUNGEN AN ORGANISCHEN REAKTORKÜHLMITTELN. (Molecular Acoustical Research on Organic Reactor Coolants). H. U. Woelk (Hahn-Meitner-Institut für Kernforschung, Berlin). 1961. 81p.

Thesis submitted to Technische Universität, Berlin.

The characteristics of organic reactor coolants and especially their change during reactor operation were investigated. An outline of the molecular acoustical theory of sound velocity in liquids and methods of measurement are given. The results of sound velocity and density measurements for 29 predominantly aromatic compounds are presented. An evaluation was made of the relation between sound velocity and the form, size, and collision characteristics of the molecules. (M.C.G.)

18620 (SL-1868(Suppl.1)) SUPPLEMENT TO REACTOR CONTAINMENT DESIGN STUDY. R. A. Johnson and I. Nelson (Sargent and Lundy, Chicago). Apr. 23, 1962. For Illinois Inst. of Tech., Armour Research Foundation, Chicago. Contract AT(11-1)-938. 92p.

A containment study is presented on a 300-Mw(e) direct-cycle boiling water reactor with internal steam separation for each of the containment concepts included in SL-1868. This plant is representative of the more advanced large-size boiling reactor plants which can be considered under present technology. The methods concerned include standard containment, pressure relief, pressure suppression, and low-pressure containment. (J.R.D.)

18621 (UCRL-6076(Suppl.1)) THE 4K ANGIE CODE. Stuart P. Stone (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 5, 1962. Contract W-7405-Eng-48. 23p.

The ANGIE Code, one of a series of reactor neutronic programs for an IBM 709 or 7090 data processing system, solves the time-independent, multi-group, neutron diffusion equation for 1 to 26 energy groups applied to a rectangular mesh superimposed on either an x-y or an r-z plane. (auth)

18622 (UCRL-6729) REACTIVITY EFFECTS OF VARIOUS REFLECTORS ON NEAR-HOMOGENEOUS, BeO-MODERATED, ORALLOY-FUELED SYSTEMS. John R. Morton, Frederick J. Shon, Thomas F. Weirich, and Loren L. Gardner (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 2, 1962. Contract W-7405-eng-48. 18p.

Measurements were made of the reactivity changes caused by reflectors of various materials on BeO-moderated, U^{235}-fueled subcritical systems with a moderator-to-fuel ratio of 247. The reflector materials included aluminum, steel, copper, brass, type 304 stainless steel, nickel, René 41, Hastelloy R-235, and BeO. The pulsed neutron technique was used. The data are tabulated in terms of the subcritical time constant as a function of reflector thickness and surface density. (auth)

18623 ANALOGUE COMPUTOR CIRCUITS FOR REACTOR EQUATIONS. H. Jung and W. Giesser (Brown Boveri Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomwirtschaft, 7: 74-9(Feb. 1962). (In German)

An analog computer circuit was developed for the investigation of the dynamic short term behavior of thermal reactors which permitted calculation through any desired number of decades. First of all the physical facts leading to the development of the method are set out. These considerations underlie a thermal reactor of sufficient size to justify the application in the dynamic equations of spatially integral quantities. A rigorous solution is given for the case of step function changes in reactivity which is of interest as a limiting case of ramp function changes. Ramp function changes in reactivity are not soluble by calculation in closed form. Also the solution on a normally equipped analog computer is not possible since the power alters in the course of the calculation by many powers of ten. In the description of the developed method it is shown how this problem can be solved with a circuit assembled from components which are almost all available commercially. A selection of results of the calculation carried out with the computer is reproduced. The results show that the essential characteristics of the results for step function changes are also valid for the ramp function changes. The circuit is described and discussed in detail. (auth)

18624 SPRAY EVAPORATION FOR A STEAM-COOLED HEAVY WATER MODERATED REACTOR. J. G. Collier (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Chem. & Process Eng., 43: 162-7(Apr. 1962).

Spray evaporation, defined as cooling by means of a two-phase mixture of steam and water, was suggested as an efficient method of heat removal from a reactor core. In order to make some assessment of the feasibility of using such a coolant in a steam-cooled heavy water moderated system, provisional design methods are outlined for the heat transfer and hydrodynamical aspects of the core. Although the degree of uncertainty using these methods is large, considerable improvements should become possible as soon as further data are available from experiments. (auth)

18625 STEADY TEMPERATURE DISTRIBUTION IN THE CYLINDRIC SYMMETRICAL UNIT CELL OF THE ACTIVE ZONE OF HETEROGENEOUS REACTORS IN THE CASE OF CONVECTIVE HEAT TRANSFER. G. Nemet, K. Raszl, L. Szabados, L. Szegho, and A. Toerock (Central Physical Research Inst., Hungary). Energia és Atomtech., 15: 41-6(Jan. 1962). (In Hungarian)

Differential equations were derived for determining the heat conductivity in the case of an infinitely long fuel element. Values obtained by an approximation method were compared with those derived from precise calculations on the basis of the exact temperature distribution function; a good agreement was found to exist between the two sets of data. The error arising from neglecting the axial heat conductivity increases if the cross section of the fuel element is increased and decreases with increasing length of the element. The designer must make use of the exact heat distribution data if the heat flow density at the surface is so high that the temperature of the cooling agent in the boundary region is close to that of the surface heat source. Although the differential equations were derived for bare fuel elements their validity may be easily extended to clad systems. (TTT)

18626 SELF-REGULATING NEUTRON ABSORBERS: THEIR CONTROL EFFICIENCY AND OPTIMIZATION IN A GAS-GRAPHITE REACTOR. S. Corno (AGIP Nucleare, Milan), A. Facchini, M. Giorcelli, V. Sangiust, and M. Terrani. Energia nucleare (Milan), 9: 129-40(Mar. 1962). (In English)

A method is worked out for the evaluation of extrapolation lengths for cylindrical sector type self-regulating neutron absorbers. The agreement between the theoretical provisions and the experimental results obtained by using the L54M Reactor is shown to be quite good. A relation between the extrapolation lengths of the absorbers and the angular width of their Cd sectors is deduced. An optimization procedure is then established for the choice of that absorber lattice which allows the spatial instabilities to be controlled in a gas-graphite reactor, with the minimum power loss. (auth)

18627 DIGITAL CALCULATION OF A MULTIPLYING SYSTEM WITH CYLINDRICAL LATTICE. C. Lo Surdo (SORIN, Milan) and G. Occhini. Energia nucleare (Milan), 9: 141-7(Mar. 1962). (In Italian)

The transients of a multiplying system with cylindrical lattice and positive reactivity are studied. The temperature reaction is present only in the fuel rods, and is described by a suitable functional of the power. The equations are solved on an ELEA 9001 electronic digital computer. Some of the most typical results obtained are reported. (auth)

18628 ANALYSIS OF SPACE DEPENDENT KINETICS ON MULTI-REGION REACTOR START-UP. Massao Higashi (Hitachi, Ltd., [Japan]). Nippon Genshiryoku Gakkaishi, 4: 187-93(Mar. 1962). (In Japanese)

The space dependent kinetic behavior of the multi-region reactor is calculated by the direct difference method from its subcritical state to supercritical state. This analysis contains the delayed neutron effect, the space-time dependence of the control rod absorption, and the reactivity feedback. Introducing h(t) which is a measure of transient multiplication, the analysis can be made more visible. The result shows the space-time behavior of rods contributes to reactor kinetics remarkably. (auth)

18629 THE VOID COEFFICIENT IN AN ENRICHED, WATER REACTOR. Jerome L. Shapiro (Univ. of Michigan, Ann Arbor). Nuclear Sci. and Eng., 12: 449-56(Apr. 1962).

An experimental and analytical study of the void coefficient of reactivity in the Ford Nuclear Reactor (a fully enriched, swimming pool type) was made. A stream of air bubbles was used to introduce voids. Out-of-pile calibration of the air flow system was necessary to account for variation in bubble rise velocity with average air concentration. This method is extremely simple except for the calibration procedure. With the results presented, the void coefficients of other reactors with similar fuel elements (18 plate, BSR type) can be measured without the necessity for recalibration. For the calculation of uniformly distributed void coefficients, relatively simple two-group diffusion theory is shown to be accurate provided the variation of leakage in all three dimensions is taken into account. This variation of leakage is computed by the use of a buckling iterative procedure. Second order effects, such as the variation of effective thermal neutron temperature and disadvantage factor, may be neglected. For the calculation of

localized void effects, the buckling iteration method is inaccurate due to the nonseparability of axial and radial flux distribution in this small core. To improve the accuracy an extension of this method to several region iteration is suggested. The principal value of this type of calculation is the short computer time required. (auth)

18630 SPACE DEPENDENT XENON OSCILLATIONS. Gerald S. Lellouche (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 482-9(Apr. 1962). (BNL-5573)

The effect of xenon and temperature on reactor dynamics in a free system is extended to include an explicit spatial dependence. The stability boundaries are determined in linear approximation for solid and annular cylindrical systems for several core sizes. Annular stability is found to be the hardest to achieve. It is shown that several terms in the series expansion of the fundamental are necessary to give a good representation of the stability of the first harmonic. (auth)

18631 THE EFFECT ON CALCULATED CLEAN CRITICAL ACTIVATION SHAPES OF THE USE OF TRANSPORT APPROXIMATIONS IN THE FAST GROUPS. M. Cantwell and M. Goldsmith (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 12: 490-7 (Apr. 1962). (WAPD-T-1375)

Measured fast fission activations of depleted U^{238} foils in thin clean critical slabs are compared with theoretical predictions made using the P-1 and P-3 approximations. Various methods of analyzing fast activation experiments are considered. Finally, the effect of the P-3 approximation in the fast groups on the thermal flux is studied by comparing Mn wire activations out to 50 cm in the reflector of a thin clean critical slab with several theoretical calculations. It is found that the deviations of the calculated P-1 activations from experiment increase as the observer moves farther out into the reflector. The use of the P-3 approximation gives marked improvement. As regards eigenvalues, experience in the analysis of thin clean critical slabs with highly enriched fuel and metal-to-water volume ratios from 1 to 1.7 indicates that use of the P-3 approximation in the first few fast groups results in an increase in eigenvalue of more than a per cent. (auth)

18632 A MEASUREMENT OF THE EFFECTIVE DELAYED NEUTRON FRACTION FOR THE BULK SHIELDING REACTOR-I. R. Perez-Belles, J. D. Kington, and G. DeSaussure (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 12: 505-12(Apr. 1962).

The value of the effective delayed neutron fraction was measured for a compact loading of the BSR-I by the boron-substitution technique. The value obtained was 0.0080 ± 0.0002. By adopting the value of the true delayed neutron fraction, $\beta = 0.0064 \pm 0.0002$, measured by Keepin et al., the ratio of the effective delayed-neutron fraction to the true delayed-neutron fraction is found to be 1.25 ± 0.05. When this quantity was computed by a three-group PDQ-code calculation, the result was 1.25, an agreement which suggests the validity of the computational method. (auth)

18633 ON THE INFLUENCE OF PRESSURE ON BOILING WATER REACTOR DYNAMIC BEHAVIOR AT ATMOSPHERIC PRESSURE. Richard L. Moore (R. L. Moore, Consultants, Los Angeles). Nuclear Sci. and Eng., 12: 548-50(Apr. 1962).

Reactor kinetic equations are mathematically analyzed in order to show the effect of pressure oscillation terms on the derivation of the equations. The equations are derived for steady state reactor operations. The results show that the standard reactor kinetic equation for the reactor flux which does not contain the rate of change terms will give false results. (N.W.R.)

18634 THE DEVELOPMENT OF FLUID FUEL REACTORS. Alvin M. Weinberg (Oak Ridge National Lab., Tenn.). Trans. Inst. Chem. Engrs. (London), 39: 369-88 (Dec. 1961).

All breeder reactors require frequent chemical recycle of the unburned fissile material. To illustrate this recycle, three small high-temperature liquid-fuel reactors were operated at ORNL (Homogeneous Reactor Experiments 1 and 2 (aqueous homogeneous) and the Aircraft Reactor Experiment (molten salt)). All the reactors had adequate nuclear stability. Extensive maintenance in radiation fields up to 100,000 r/h was feasible on HRE-2. Precipitation of the uranium fuel occurred in HRE-2 whenever the core-vessel wall was inadequately cooled; this chemical instability was largely corrected by improving the conditions of flow at the core wall. Although considerable success was achieved in the operation of these experimental reactors much longer operating experience will be needed to assess fully their feasibility. (auth)

18635 METHOD OF MAKING TUBULAR NUCLEAR FUEL ELEMENTS. Walter Precht, Raymond J. Geckle, and Louis Frank (to Martin-Marietta Corp.). U. S. Patent 3,015,615. Jan. 2, 1962.

A method is given for fabricating clad fuel tubes in which the bond between the fuel core and the cladding is very strong. The fuel consists of a sintered cermet containing a fissionable material in a matrix metal, and the cladding material is preferably the same as the matrix metal. The tube-shaped cermet core is swaged with inner and outer clad members, and a more intimate bonding is effected by cold drawing and sintering. An example of the method is given in which a mixture of stainless steel and UO_2 is used as the fuel with stainless steel as cladding. (D.L.C.)

18636 ROD TYPE FUEL ASSEMBLY. William E. Sturtz and Erling Frisch (to Westinghouse Electric Corp.). U. S. Patent 3,015,616. Jan. 2, 1962.

A fuel element bundle for pressurized water reactors is designed with the fuel elements detachably connected to the end plates in a way that thermal expansion is allowed and no welding is necessary. The connecting means comprise fillister-headed screws inserted through holes in the end plates for engaging trapped holes in the plug members of the fuel elements. The subassemblies in turn are secured together by means of a number of tie rods provided with sleeves for permitting expansion of the fuel elements. (D.L.C.)

18637 METHOD AND APPARATUS FOR AQUEOUS HOMOGENEOUS REACTOR SYSTEMS. Jay E. Brunings (to Foster Wheeler Corp.). U. S. Patent 3,015,617. Jan. 2, 1962.

A homogeneous reactor system is designed with means for removing fission product gases from the system. The means comprises a pressurizer vessel with a gas space for stripping the fission product gases from the fuel solution. Oxygen is used as the pressurizing gas. A condenser is also arranged in the gas space of the pressurizer vessel with means for passing the condensed water to the canned pump for purging. (D.L.C.)

18638 MULTI-LAYER VESSEL HAVING A GAMMA RAY FLUX ABSORBING LAYER. Warren Hendricksen and Howard H. Needham (to A. O. Smith Corp.). U. S. Patent 3,016,462. Jan. 9, 1962.

A multi-layer reactor pressure vessel is designed with one of the layers formed of a material having a high rate of gamma absorption. The gamma-absorbing layer should be adjacent a cooling surface or a cooling passage, and its material should be one having a density >8.0 g/cm^3, e.g., Pb, Cd, Hg, etc. (D.L.C.)

18639 MULTI-LAYER VESSEL HAVING A NEUTRON ABSORBING LAYER. Howard H. Needham (to A. O. Smith Corp.). U. S. Patent 3,016,463. Jan. 9, 1962.

A reactor pressure vessel is designed with a wall section formed of a plurality of relatively thin metal layers with a neutron-absorbing layer disposed between two layers. The neutron-absorbing layer should be made out of a material with a thermal neutron cross section of >200 barns and a high thermal conductivity, and it should be adjacent a cooling surface or a cooling passage. Two embodiments of a multi-layer wall section are described. (D.L.C.)

18640 GRAPHITE ASSEMBLIES FOR NUCLEAR REACTORS. James Wilfred Ashley and Leslie James Knight (to United Kingdom Atomic Energy Authority). U. S. Patent 3,016,765. Jan. 16, 1962.

A link for the restraint system of a graphite reactor structure is designed for increased ability to function despite corrosion. The link comprises a nest of coaxial tubes for compressive loads, a plurality of pairs of end plates, a pair of couplings attached to the outermost pair of end plates, and a plurality of groups of tie rods for carrying tensile loads. The wall of each tube is thicker than that of the tube surrounding it. (D.L.C.)

18641 NUCLEAR REACTOR MODERATOR STRUCTURES. William Rodwell (to United Kingdom Atomic Energy Authority). U. S. Patent 3,022,239. Feb. 20, 1962.

A graphite moderator structure for use in a reactor-powered ship is designed with compensation for Wigner growth. The structure comprises layers of graphite blocks alternating with layers of graphite tiles. The blocks have minimum Wigner growth in the direction of their length, and the tiles have minimum Wigner growth in a direction perpendicular both to that of minimum Wigner growth in adjacent tiles and to the length of the blocks. After irradiation, the side faces of the tiles remain in contact, although their axes move apart. Centripetal restraint means is provided for each layer of tiles. (D.L.C.)

18642 DEVICES FOR INTRODUCING ELEMENTS, AND IN PARTICULAR FUEL RODS INTO NUCLEAR REACTORS AND/OR FOR WITHDRAWING SUCH ELEMENTS FROM SAID REACTORS. Roger Martin and Maurice Moulin (to Commissariat à l'Énergie Atomique). U. S. Patent 3,025,226. Mar. 13, 1962.

A reactor loading and unloading device is described which permits the reduction to a minimum the number and dimensions of the openings in the reactor casing. The channels of the reactor core are fitted at both ends with bent tube extensions, the open ends of the tubes being located in a spherical surface with its convexity toward the core and the tubes being shaped so that the portions near their open ends are at right angles to the spherical surfaces. The casing carries two swinging tubes swivelled about the centers of curvature of the spherical surfaces so that the swinging ends can be brought into register with any of the extension tubes for fuel element introduction into, or withdrawal from, the core. Two embodiments of the device are described, one for vertical channels and the other for horizontal channels. (D.L.C.)

18643 BORON TRIFLUORIDE REGULATING SYSTEM. Robert L. Whitelaw (to Babcock and Wilcox Co.). U. S. Patent 3,025,228. Mar. 13, 1962.

A reactor safety and control device using BF_3 gas is designed for use during normal reactor operation. The BF_3 device has a container of liquid BF_3 connected to control tubes in the reactor zone; cooling means controls the temperature of the liquid and hence sets the BF_3 pressure in the control tubes. An embodiment of the BF_3 device is described in association with a D_2O test reactor employing scram control rods for emergency shutdown. (D.L.C.)

18644 NUCLEAR REACTOR. Charles Beurtheret (to Compagnie Française Thomson-Houston). U. S. Patent 3,034,975. May 15, 1962.

A reactor of both the boiling and pressurized water types is designed for prevention of calefaction and for improved efficiency. The fuel elements have on their surfaces large corrugations or protuberances, and the coolant circulation is regulated so that the maximum temperature of the coolant adjacent to the fuel elements is at least 10°C less than the boiling temperature at the pressure existing in this region. Thus, heat transfer is effected by coolant vaporization, but the vapor condenses after a short time, and only hot liquid leaves the reactor zone. The liquid in the reactor zone is kept in direct communication with an open surface of liquid in contact with its vapor so that volume fluctuations due to local boiling take place at constant pressure. (D.L.C.)

Power Reactors

18645 (AFSWC-TDR-61-100(Vol. I & II)) AVAILABILITY ANALYSIS FOR NUCLEAR POWER PLANTS. G. Hefferon (American Machine and Foundry Co., Greenwich, Conn.). Dec. 1961. Contract AF29(601)-4561. 177p.

A method of determining the probability of successful operation of a nuclear power generating station for any minimum acceptable fraction of a given operating cycle is described. A digital computer program is provided to carry out the required calculation and automatically indicate the return to be expected from improved reliability and redundancy in the weakest component. Sample calculations for EBWR and PM-1 are presented to illustrate the use of the method. It is shown that in order to increase the accuracy of these probability calculations better reliability data are required, in particular on components specifically designed for inclusion in nuclear power plants. To overcome this difficulty, a proposed reliability data gathering procedure is presented. The procedure is based upon the use of punched cards to facilitate data handling. An additional computer program is provided to accept component failure, repair data, and plant operating history, and to produce failure rate and average repair time information. (auth)

18646 (APAE-95) FAST NEUTRON FLUX MEASUREMENTS AND ANALYSIS IN SM-1 AND PM-2A CORE AND VESSEL MOCKUPS. K. C. Sontheimer, S. N. Kemp, L. Lois, E. F. Clancy, and W. J. McCool (Alco Products, Inc., Schenectady, N. Y.). Mar. 31, 1962. Contract AT(30-1)-2639. 163p.

Experimental and analytical work performed on cold clean SM-1 Core II with special components and PM-2A Core I each with thermal shield and vessel mockups is summarized. The neutron intensity and spectra to which the pressure vessels are subjected are defined in order to assess the effect of irradiation on the vessel lifetimes.

The radial distributions of the energy dependent neutron flux per unit power in the core and vessel mockups are presented. The uncertainties associated with the measurements are also given. In addition to graphical and tabular presentations of the test results, discussions are provided on the experimental techniques and theory. A review of the analytical models is provided in addition to the calculational results. A special analytical study of the PM-2A Core I power distribution and absolute power level determination is given. A comparison of the experimental and analytical results was made, and conclusions and recommendations are presented. (auth)

18647 (APAE-103) SUMMARY REPORT OF ANALYSIS OF PHYSICS MEASUREMENTS PERFORMED ON SM-1 CORE I. L. Lois, ed. (Alco Products, Inc., Schenectady, N. Y.). Mar. 30, 1962. Contract AT(30-1)-2639. 207p.

A comprehensive analysis was made of the nuclear characteristics of the SM-1 Core I. Comparison of analytical and experimental results for neutron ages and core reactivities of a variety of cases investigated showed that the MUFT III with P-1 slowing down approximation gives the best results. At startup the core reactivity and rod bank worth under various operating conditions are investigated and compared to experiment. Core lifetime was calculated to be 16.8 MWYR compared to 16.4 MWYR experimental. The temperature coefficient was calculated and compared to experiment as function of burnup. Flux distribution, temperature coefficient, effective delayed neutron fraction, and core life were analyzed by one and two group modified theory and series expansion calculations. (auth)

18648 (APAE-111) PM-2A CORE II ZERO POWER EXPERIMENT. L. D. Walthousen, J. V. Mageean, T. M. Raby, and D. H. Lee (Alco Products, Inc., Schenectady, N. Y.). Mar. 30, 1962. Contract AT(30-1)-2639. 74p.

The zero power experiments performed on PM-2A Core II at the Alco Critical Facility are reported. PM-2A Core II is the first replacement core for a portable pressurized reactor. Core II is the same as Core I with the exception that Core II has an increased burnable poison (B^{10}) content. The zero power experiment consisted of fuel element uniformity test, core assembly test, development of an on-site loading procedure and an analysis of experimental data. Physical characteristics determined include distribution of fuel and B^{10} in the fuel plates, minimum critical mass, control rod bank calibration, and integral rod worth. An analysis of the experimental data with estimated uniform and non-uniform burnup rates is included. (auth)

18649 (APAE-Memo-283) PRELIMINARY STRESS AND FATIGUE ANALYSIS OF THE SM-1 PRIMARY SYSTEM. R. A. Chittum, R. K. Knipe, and D. W. McLaughlin (Alco Products, Inc., Schenectady, N. Y.). Mar. 31, 1962. Contract AT(30-1)-2639. 74p.

A preliminary analysis of the SM-1 primary system showed it was safe from strain cycling damage with the possible exception of steam generator tube sheet and primary pump casing. These are recommended for further analysis. (auth)

18650 (APAE-Memo-314) PL-3 PROJECT QUARTERLY PROGRESS REPORT, JANUARY 1, 1962–MARCH 31, 1962. G. E. Humphries (Alco Products, Inc., Schenectady, N. Y.). Apr. 10, 1962. Contract AT(30-1)-2900. 64p.

Progress is reported on phase II in sections on final design, procurement, fabrication, testing, packaging, and crew training. A summary of completed phase I work on concept evaluation and preliminary design is also included. (J.R.D.)

18651 (BAW-1241) SPECTRAL SHIFT CONTROL REACTOR DESIGN AND ECONOMIC STUDY. D. Mars (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.), and D. Gans, Jr. (Stone and Webster Engineering Corp., New York). Dec. 1961. Contracts AT(30-1)-2602 and AT(30-1)-2738. 262p.

A study of nuclear power plants is presented which incorporates the Spectral Shift Control Reactor (SSCR)–a pressurized water reactor featuring a unique method of reactivity control. The moderator-coolant is a mixture of light and heavy water whose D_2O concentration changes from 60 to 80 mole % at the beginning of core life to 2 mole % at the end. The only control rods required at full power are a group of four partially inserted rods used for fine control. Zone-loading of fuel therefore produces a core of low power peaking and high power density. Further, the absence of control poisons and the relatively high epithermal neutron absorption of the fertile material result in a high conversion ratio. Plant designs, operating characteristics, and economics are presented for three current-status plants and for a "potential" plant. The current-status plants, which can be built today using current technology, develop net electric outputs of 154; 330; and 458 megawatts. The reactor cores are fueled with low enriched UO_2 and clad with either Zircaloy or stainless steel. The generating cost for a 330 MWe combustible-fuel-fired plant located in New England is estimated to be 6.7 mills per kilowatt-hour compared with 6.37 for the SSCR plant of the same capacity. The potential plant, developing a net electric output of 333 megawatts, has a core clad with thin-walled Zircaloy and fueled with Th and U oxides. This core features recycling of the U^{233} bred by neutron capture in Th. The core design is based on the successful results of a proposed research and development program costing $5,145,000. (auth)

18652 (DP-706) PROCESSING OF POWER REACTOR FUELS SIXTEENTH QUARTERLY PROGRESS REPORT, JULY 1 TO OCTOBER 1, 1961. Francis G. Rust, comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1962. Contract AT(07-2)-1. 24p.

In the semiworks dissolver, average currents were about 2000 amp during dissolution of stainless steel and about 1200 amp during dissolution of Zircaloy. These currents were obtained when the current was transferred to a fuel assembly by direct contact with the columbium basket. High dissolution rates are anticipated when the dissolver is modified so that the electrolyte makes the only electrical contact with the charge. Laboratory experiments were made to determine the important characteristics of this type of dissolver. High corrosion rates of stainless steel equipment by boiling nitric acid–stainless steel solutions (under evaporator conditions) is caused by Cr^{+6}. (auth)

18653 (FXM-402) EFFECT OF VARYING THE FUEL ELEMENT DIMENSIONS ON THE AMOUNT OF URANIUM AND STAINLESS STEEL IN THE REACTOR. T. S. Moy (Pratt and Whitney Aircraft Div., United Aircraft Corp., [Hartford, Conn.]). Apr. 28, 1953. Contract AT(11-1)-229. 6p.

Results of a study are presented concerning the uranium-stainless steel quantitative relations over a range of reactor fuel element dimensions for use in a critical experiment. Only the size and shape of the triangular channels were varied while other variables in the element were held constant. (J.R.D.)

18654 (FXM-429) RADIATION HEATING IN THE SCW REACTOR. John A. Riley (Pratt and Whitney Air-

craft Div., United Aircraft Corp., Hartford, Conn.). May 29, 1953. Contract [AT(11-1)-229]. 48p.

Local gamma radiation flux distributions were calculated by applying test results of gamma attenuation theory to a simplified model of the SCW reactor. Neutron flux distributions were determined by a five-group diffusion calculation. Local power generation in the moderator and reflector water is expressed in terms of the total radiation flux, and a first approximation to the water density distribution obtained by calculating in a step-wise manner the enthalpy increase in the moderator and reflector flows. Maps of the various distributions are presented, and a program for improving the approximation to the water densities is devised. (auth)

18655 (FXM-479) MODERATOR FLOW SCHEMES WITH REDUCED DENSITY VARIATION. A. I. Chalfant (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Aug. 13, 1953. Contract [AT(11-1)-229]. 7p.

A flow scheme is described in which the reactor thermal shield and moderator are in parallel. This scheme was previously shown to produce large density gradients in the moderator pass which cause difficulty in predicting the neutron flux distribution. Rough calculations concerning two alternative flow schemes are presented to demonstrate that they warrant further consideration. (J.R.D.)

18656 (GAMD-1895) ANALYSIS OF VARIOUS METHODS OF HOLDING THE HTGR CORE. F. B. Nimtz (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Dec. 19, 1960. Contract AT(04-3)-314. 31p.

Methods of holding the fuel elements during reactor operation are discussed. It was concluded that the tilting reflector should be given further study. This method involves fixing the outside reflector and letting the inside reflector pivot at the bottom allowing the full pressure load on the reflector to be exerted on the core. (J.R.D.)

18657 (HPR-18) HALDEN BOILING WATER REACTOR QUARTERLY PROGRESS REPORT, OCTOBER TO DECEMBER 1961. (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). 75p.

Activities at the Halden reactor include preparation of a hazards summary for the second core loading, reactivity budget and lattice parameter calculations for the second core loading, control rod reactivity worth calculations, interpretations of first core dynamic experiments, analysis of first core corrosion products for radioisotopes, modifications of heat exchangers, radiation monitors, and other reactor components, and design and installation of instrumentation. (T.F.H.)

18658 (HW-71214) PRP-CF START-UP TESTS. L. C. Schmid, F. C. Engesser, J. R. Fishbaugher, V. W. Gustafson, and W. P. Stinson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 29, 1962. Contract AT(45-1)-1350. 35p.

The Plutonium Recycle Program-Critical Facility start-up tests are described. The following tests are discussed: loading to critical, power calibration experiment, worth of the rods in the safety system, reproducibility and calibration of the control rods, time response of the safety system, moderator level reactivity coefficients with two-zone loading, cell pressure and total temperature coefficients with two-zone loading, Pu–Al substitution, void and water-heavy water substitution coefficients, kinetics measurement, reflector experiment, and boron poison injection. (M.C.G.)

18659 (MND-M-1822) PM-1 NUCLEAR POWER PLANT PROGRAM. 11th Quarterly Progress Report, September 1, 1961 to November 30, 1961. (Martin Co. Nuclear Div., Baltimore). Jan. 2, 1962. Contract AT (30-1)-2345. 55p.

Progress is reported on development, plant installation, and testing of the PM-1 reactor. Core fabrication, wet critical testing, and delivery to the site were accomplished. All major installation and construction were completed. Assembly verification testing and pre-startup testing were initiated. (M.C.G.)

18660 (NAA-SR-4534) STRESS ANALYSIS OF BELLOWS FOR THE HNPF INTERMEDIATE HEAT EXCHANGER. R. Chipman, R. Galantine, and J. Susnir (Atomic International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1962. Contract AT (11-1)-Gen-8. 59p.

A combined theoretical and experimental stress analysis was performed on a bellows to determine if it was suitable for use in absorbing the differential expansion between the shell and tubes of the intermediate heat exchanger for the Hallam Nuclear Power Facility (HNPF). Modes of deformation imposed, singly and in combination, upon a prototype bellows at room temperature included axial deflection, lateral deflection, angular rotation, torsional rotation, and pressurization. Good agreement was obtained between predicted and observed strains. All subsequent tests were performed with Na at 75 psig and 1000°F inside the bellows. During the first series of these tests, which simulated the cycling effects of 20 years of normal reactor operation, negligible damage occurred in the bellows. The second series of tests, with Na at 75 psig and 1000°F, showed that the bellows could withstand the large axial deflections which might occur during abnormal conditions involving failure of a pump in either the primary or secondary cooling system. In the final series of tests, the axial deflection stroke was gradually increased in a deliberate attempt to induce failure in the bellows. When the stroke was increased to approximately 30 times that expected during normal operation, a reproducible signal was obtained indicating that Na had leaked through the inner ply of the double-ply wall. Even at that time, there was no leakage of Na through the outer ply and the bellows still remained functional. It was concluded that the bellows is well suited for application in the HNPF intermediate heat exchanger. (auth)

18661 (ORNL-3261) NUCLEAR ANALYSES OF THE N. S. SAVANNAH REACTOR WITH ZIRCALOY OR STAINLESS STEEL AS FUEL-ELEMENT CONTAINERS. E. E. Gross, B. W. Colston, and M. L. Winton (Oak Ridge National Lab., Tenn.). May 8, 1962. Contract W-7405-eng-26. 70p.

Nuclear comparisons were made of Zircaloy and stainless steel as fuel-element container materials in the N. S. SAVANNAH core I design. In order to make the comparison, a four-group model employing a combination of one-dimensional S_n transport-theory and two-dimensional diffusion-theory calculations was devised. The main features of the analytical model are geometrical detail and the use of the S_n method to obtain transport-theory equivalent-boundary conditions at the surface of control rods. Application of the four-group model to the N. S. SAVANNAH core I design revealed that, relative to stainless steel fuel-element containers, a Zircaloy fuel-element container structure would increase control rod worth by $\Delta k = 0.043$ and would increase core reactivity by $\Delta k = 0.062$ for the same fuel enrichment. Although these two fuel-element container materials produced slightly different power distributions, the over-all peak-to-average power ratio appeared to be the same. In order to complete the comparison, simple one-dimensional radial burnup cal-

culations were performed. The burnup calculations indicated that the heterogeneous effect of the fuel-element containers on control rod worth would allow a 60% increase in the reactivity lifetime of core I-type fuel elements in Zircaloy fuel-element containers relative to the reactivity lifetime attainable in stainless steel fuel-element containers. (auth)

18662 (OSB-6) REPAIR OF DAMAGED SM-1 CONTROL ROD END CAPS. Thomas J. Hoffmann (Corps of Engineers. Nuclear Power Field Office, Fort Belvoir, Va.). Oct. 11, 1960. 34p. (AD-265580)

During rearrangement of the fuel elements in the SM-1 core, four control rod end caps were damaged because of improper removal procedures. Further unavoidable damage to the end caps occurred in subsequent removal operations. Because of the long lead time necessary to obtain new caps and also because of the large cost involved, it was decided to repair the damaged parts at Ft. Belvoir, Virginia. A water shield tank and remote handling tools were fabricated, the control caps were disassembled, damaged parts were replaced with locally fabricated substitutes, and the reassembled units were put back into service. All work was successfully accomplished without subjecting personnel to dangerous radiation. (auth)

18663 (OSB-13) SHIELD TANK CLEAN UP AND COMMERCIAL FILTER HANDLING AT THE SM-1. Period covered: May 1, 1960 to November 1, 1960. R. E. Baach (Crops of Engineers. Nuclear Power Field Office, Fort Belvoir, Va.). 22p. (AD265581)

The process employed in the purification of the shield tank water, the handling of the commercial filters used during the clean-up operation, the disposal of the radioactive filters, and the main problems of the filtering system are presented. A summary of possible alternate procedures is included. It is concluded that: the system as used is an expedient temporary method of cleaning up; the handling of a filter using nerve gas cylinders and Conex containers is a tedious operation, and the radiation readings on the Conex containers exceed the ICC regulations; the replacement of the Conex container with a concrete cask that meets ICC regulations is not practical because of the concrete cask's size, weight, and cost; design of an insert for placing filters in the lead demineralizer cask is complete; and use of the demineralizer instead of filters is acceptable for one-time use. (auth)

18664 (OSB-15(Rev.1)) FINAL REPORT ON INVESTIGATION OF SM-1 CONTROL ROD SEAL FAILURE. REVISION 1: JOB 63—INSPECTION OF SM-1 CONTROL ROD SEAL COMPONENTS. R. A. Chittum, H. R. Clayton, R. M. Saccocio, and C. A. Bergmann (Alco Products, Inc., Schenectady, N. Y.). June 16, 1961. For Corps of Engineers. Nuclear Power Field Office, Fort Belvoir, Va. Contract DA-44-192-ENG-17. 33p. (AP Note-362; AD-265582)

A laboratory test was completed to check leakage rates of a control rod drive seal assembly (shaft, seal rings, and diaphragms) which had been in operation in the SM-1 since its original startup. The testing was performed at simulated reactor operating pressure (1200 psi) and room temperature to determine the leakage rate with the seal correctly assembled and with it assembled as it had been during reactor operation i.e., the first diaphragm and seal ring turned around on the seal shaft. No measurable wear was found when the components were measured. Micrographical examination of the Cr plate on a seal shaft removed from the SM-1 showed considerable pitting, corrosion, and erosion under and adjacent to some of the stellite ring areas. The most likely cause of removal of the Cr plate was the poor quality plating and inadequate preplate cleaning which resulted in non-metallic inclusions in the material. (auth)

18665 (OSB-16) REMOVAL OF DAMAGED SM-1 CONTROL ROD BASKET. John C. Bouldin (Corps of Engineers. Nuclear Power Field Office, Fort Belvoir, Va.). Sept. 15, 1961. 23p. (AD-265583)

During rearrangement of the elements in the SM-1 core, a control rod basket was damaged so severely that it had to be replaced. The damaged basket assembly was left in the inner shield tank while a safe and practical method of removal could be devised. Several possible solutions to the problem were considered. The method finally selected involved cutting the basket underwater by means of a remote cutter and removing the separate pieces through the fuel transfer chute. This method proved to be effective and the damaged basket was successfully removed without undue difficulty. The basket sections were loaded into a spent fuel cask and shipped to ORNL on May 8, 1961. (auth)

18666 (OSB-18) INSPECTION OF EUROPIUM-BEARING ABSORBER RODS FOR REACTIVITY CONTROL IN CORE II OF SM-1. Thomas J. Hoffmann (Corps. of Engineers. Nuclear Power Field Office, Fort Belvoir, Va.). Aug. 23, 1961. 28p. (AD-265584)

During reloading of the SM-1 core, inspection of the Eu_2O_3 dispersion-stainless steel control rod elements was performed. Outside box dimensions and plate thicknesses were mechanically measured for all the europium absorber elements in the inner shield tank and the results were compared to data taken at ORNL before the elements were exposed to radiation. The results of this comparison showed that no noticeable swelling had occurred. All work was successfully accomplished without subjecting personnel to excessive radiation. (auth)

18667 (PRDC-TR-54) MONTHLY TECHNICAL REPORT [ON POWER REACTOR DEVELOPMENT], DECEMBER 1961. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 17p.

Activities are summarized on core design, graphite testing, materials development, nuclear engineering, electrical and instrumentation, liquid metal and steam systems, and test operations. (J.R.D.)

18668 (RADC-TR-59-77) POWER PLANT EFFICIENCY ENHANCEMENT. Final Report, June 10, 1958 to April 10, 1959. E. Gyory and C. C. Miesse (Illinois Inst. of Tech., Chicago. Armour Research Foundation). June 1959. Contract AF 30(602)-1911. 73p. (AD-217407)

The feasibility of improving the performance of nuclear power plants for arctic installations was studied. Various power plant cycles which would take advantage of the low temperature heat sink available in the Arctic region were analyzed. It was concluded that the addition of a secondary cycle to the existing steam cycle of present nuclear power plant cycles such as the Army Package Power Reactor (SM-1) and the Argonne Low Power Reactor (SL-1) will result in increasing the thermal efficiency by a factor of approximately 1.4. In addition to this binary cycle, a single cycle replacing the steam cycle indicates promise. A refrigerant such as Freon-12 would be used as a working fluid. (auth)

18669 (SL-1915-3) ENGINEERING EVALUATION STUDIES [ON] HEAVY WATER MODERATED POWER REACTOR PLANTS. Quarterly Progress Report, January–March, 1962. (Sargent and Lundy, Chicago). Apr. 25, 1962. Contract AT(38-1)-213, modifications 4, 5, and 6. 12p.

Work on the computer program for the economic optimization of D_2O moderated power reactors is continuing. Optimized designs were established for three D_2O cooled plants. These are: the liquid cooled, UO_2 and U-metal fueled indirect cycle plants; and the boiling D_2O cooled, UO_2 fueled, direct cycle plants. The scope of work was extended to include a computer analysis of organic cooled, D_2O moderated power reactors. The reactor is a pressure tube type fueled by either UC or UO_2. The fuel cladding and pressure tube materials are Aluminum Powder Material (APM) and the plants will have a nominal 300 MW(e) (net) capacity. The same general design and cost philosophy developed for the D_2O cooled plants will be used in this program and the plant facilities and systems will be kept as nearly identical as possible to those used for the D_2O cooled units, except where the use of the organic coolant dictates a difference. Work is presently in progress to develop the design and cost equations for the organic auxiliaries and reactor plant structures. A preliminary set of general arrangement drawings for the organic plant was prepared. (auth)

18670 (TID-14884) FEDAL SYSTEM OPERATION DURING STATION STARTUP. Test Evaluation. Section 2. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 25, 1962. Contract [AT(11-1)-292]. 83p. (DLCS-3500261)

A test to monitor all of the blanket elements during PWR station startups was conducted to detect fuel element failures. Data and diagrams are included concerning FEDAL system operation during startup. (J.R.D.)

18671 (TID-14885) EXTERNAL RADIATION LEVELS OF REACTOR COOLANT LOOP PIPING AND PURIFICATION DEMINERALIZERS. CORE I, SEED 2. Test Evaluation (T-612076-A). Section 1. (Duquesne Light Co., Shippingport, Penna.). First Issue, Feb. 1, 1962. 35p. (DLCS-3410101)

A test was conducted to obtain data on the build-up of corrosion product activity in the PWR coolant piping and purification system demineralizers. Results are summarized and data on radiation levels are included. (J.R.D.)

18672 (UNC-5004) FAST REACTOR SAFETY. Progress Report for the Period January 15, 1962. J. Agresta and A. Goldman (United Nuclear Corp. Development Div., White Plains, N. Y.). Jan. 31, 1962. Contract AT(30-1)-2832. 23p.

Theoretical investigations concerning the safety of fast power reactors are described. Development of simplifications and approximations to the equations describing heat transfer in generalized reactor channels are reported. These were tested numerically in predicting the incipience of coolant boiling and fuel melting in a reactor experiencing an exponential power transient. The reactivity studies were concerned with fast reactor operation with a prompt positive coefficient and a delayed negative reactivity coefficient of the conduction type. Power excursions for step insertions of reactivity and initial powers below the instability threshold were studied by numerical integration of the nonlinear prompt-jumps equations. Over the range tested, as the initial power approaches the instability threshold, the fractional power overshoot in these excursions decreases. (J.R.D.)

18673 (FTD-TT-61-340) EXPERIMENTAL UNIFLOW STEAM SUPERHEATING REACTOR INSTALLATION OF THE FIRST ATOMIC POWER PLANT. V. V. Dolgov, V. Ya. Kozlov, L. A. Kochetkov, O. A. Sudintsyn, V. V. Sergeev, and G. N. Ushakov. Translated from p.27-40 of "Power Reactor Experiments. Proceedings of a Symposium, Vienna, 23-27 October 1961. Vol. II" (a publication of the International Atomic Energy Agency, 1962. (STI/PUB/51(Vol.II)(p.27-40)). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11269.

18674 METHODOLOGY OF COST CALCULATION IN NUCLEAR POWER STATIONS. [PART] III. Walter Baur. Atomwirtschaft, 7: 89-91(Feb. 1962). (In German)

The atomic energy industry is giving rise to new operating economic problems and is causing a change in the existing methods of costing. A general cost equation for all reactor types is worked out which makes possible an exact calculation of energy costs and, further, provides a basis for operational arrangements in nuclear power stations. It takes into equal consideration economic, technical, and nuclear-physical points of view since only a total study of a projected reactor construction and of possible technical and costwise improvements during operation gives a picture of the profitableness of the installation. (auth)

18675 STEAM REHEATER FOR NUCLEAR STATION. F. W. Gettler, Jr. and J. H. Potter (Gibbs and Hill, Inc., New York). Mech. Eng., 83: 70-3(Dec. 1961).

Five of the various cycles for all-nuclear-powered pressurized-water reactor systems for the Enrico Fermi station, SELNI, are presented to show their relative effectiveness. The base parameters of steam and feed flow, steam and feed conditions, and turbine-exhaust pressure were the same in all five cycles. Heat input was fixed and the output was determined for each variation of the cycle. The cycle chosen is distinguished by the inclusion of a steam-to-steam reheater between the high and low-pressure turbines. Although about 7% of the throttle steam will be diverted from useful work in the turbines to supply the energy for the reheater, the reheater will reduce cost per kilowatt generated due to the improvement in the turbine cycle efficiency and will increase life expectancy of the turbine as the lower moisture content of the steam in the low-pressure turbine will produce less erosion. (N.W.R.)

18676 THE NEW POWER STATIONS. G. R. Bainbridge (United Kingdom Atomic Energy Authority, [Harwell, Berks, Eng.]). Nuclear Energy, 158-64(Apr. 1962).

Improvements made in basic design and construction techniques over a period of five years for the Calder Hall type reactors are examined and discussed with respect to economic factors. Information from research work on reactor materials and safety systems was also studied so that better designs at lower costs may be achieved. With the present rate of progress, new power stations based on nuclear fuel will be fully competitive with coal- and oil-fired plants within ten years. The locations and sizes of British reactors are given along with reactor characteristics. (N.W.R.)

18677 DESIGN OF EDF-1 BLOWER. M. Allemann and H. Benz (Sulzer Bros. Ltd., Winterthur, Switzerland). Nuclear Eng., 7: No. 72, 192-5(May 1962).

The design and characteristics of the EDF-1 main coolant circuit carbon dioxide blower are described. The blower handles carbon dioxide at a pressure of 25 atm, the flow rate being controlled by adjustable inlet guide vanes. The seals of the blower shaft and servo-motor spindles are designed for replacement under full pressure. The blower operates at a compression ratio of 1.06. (N.W.R.)

18678 BERKELEY NUCLEAR POWER STATION. THE PRIMARY CIRCUIT. Nuclear Power, 7: No. 73, 47-52(May 1962).

Design and construction aspects of the primary circuit of the pressure vessel, gas ducts and circulators, and heat exchangers are discussed. A list of the Berkeley parameters is also given. (P.C.H.)

18679 POWER REACTOR TECHNOLOGY. Technical Progress Review, Vol. 5, No. 2. Walter H. Zinn (General Nuclear Engineering Corp., Dunedin, Fla.). Mar. 1962. 76p.

A review of progress in the areas of reactor physics and heat transfer and fluid flow are presented. Also included is information on reactor safety and dynamics concerning transients in a UO_2-H_2O reactor, dynamics of EBR-I and melting of fast-reactor fuel elements. Other sections contain information on design of the Elk River Reactor, Pathfinder control rods, development of Be materials and Zr pressure tubes. Operating experience at Dresden and with the BORAX-IV is summarized, and aspects of containment related to the HWCTR and BONUS are discussed. (J.R.D.)

18680 FUEL ELEMENT. Andrew Wetherbee McReynolds and Lieuwe J. Dijkstra (to General Dynamics Corp.). U. S. Patent 3,019,176. Jan. 30, 1962.

A method is given for fabricating a solid homogeneous fuel element with high thermal conductivity, structural strength, radiation resistance, and inherent safety for use in a reactor described in U. S. Patent application Serial No. 664,706. The fuel element comprises a mixture of particulate fissionable material (UO_2) and a solid metal hydride (ZrH_2) dispersed in a radiation-resistant matrix (Al or Mg). (D.L.C.)

18681 SUBSURFACE CONTAINMENT FOR NUCLEAR POWER REACTORS. George P. Dix (to Martin-Marietta Corp.). U. S. Patent 3,021,273. Feb. 13, 1962.

An inexpensive and simple containment device is designed which will effectively retain incident products from nuclear accidents. Part or all of the reactor is located in an underground chamber lined with concrete or other impermeable material. An aggregate of heat-conducting particles is placed in the chamber to surround the reactor. The particles may be quartz or aluminum spheres of diameter 0.25 to 1 inch. An analysis of the factors affecting the time needed to condense the steam from a MPR pressurized-water reactor after excursion is presented. (D.L.C.)

18682 GAS COOLED POWER REACTORS. Peter Fortescue and George Edward Lockett (to United Kingdom Atomic Energy Authority). U. S. Patent 3,034,976. May 15, 1962.

A gas-cooled power reactor of the solid homogeneous type, in which the moderator and fuel are combined, is designed for operation at a high temperature. The core and reflector assembly comprises a plurality of core members pivotally supported at their lower ends and adapted to be held together at their upper ends by the coolant differential pressure. The coolant path is such that the stressed parts are maintained at a temperature close to that of the incoming gas. Because the core elements and reflector blocks contact each other only at the upper ends, the reactor can tolerate considerable distortion and/or growth. (D.L.C.)

Production Reactors

18683 (HW-71674) BROACHED NOZZLE STRENGTH FOR CGI-558 AND K-AREA DESIGN NOZZLES SUMMARY REPORT. D. E. Sebade (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 13, 1961. Contract [AT(45-1)-1350]. 11p.

It is noted that a previous recommendation was made to install nozzles broached for bumper fuel elements without safety sleeves. The basis on which the relative strength of the broached inlet nozzles for all areas may be demonstrated is provided. An absolute standard for nozzle strength is not provided. (J.R.D.)

18684 SPECTRAL SHIFT CONTROL REACTOR. R. W. Deuster and Z. Levine. Mach. Eng., 83: 44-7(Oct. 1961).

The Spectral Shift Control Reactor is a variation of the pressurized-water reactor. Reactivity control is accomplished by varying the concentration of a heavy water-water mixture in the primary loop of the reactor. The addition of heavy water changes the relative number of neutrons at any particular energy (that is, shifts the neutron spectrum), resulting in more neutrons at slightly higher energies and more absorptions in fertile material. The percentage of heavy water will be highest at the beginning of core life. The reactor, therefore, reduces capital investment and fuel costs, and conserves nuclear reserves. Other advantages are higher power density, uniform fuel burn-up, higher thermal efficiency, longer core lifetime, and improved conversion ratio. The characteristics are graphically and tabularly presented. (N.W.R.)

Research Reactors

Refer also to abstract 18156.

18685 (ACNP-6126) THREE DIMENSIONAL ANALYSIS OF BOOSTER ROD SYSTEM FOR CANDU. Final Report. R. J. Holl and P. S. Lacy (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Dec. 6, 1961. Contract AT(38-1)-263. 46p.

A computer study program was performed to determine three-dimensional two-group flux distributions in the CANDU reactor, and the booster rod loading required to provide 10 mk of reactivity. The fluxes were computed at equilibrium full-power operation and during Xe transient with the booster rods fully inserted. The 25-min Xe build-up was found to introduce a reactivity loss of 9.0 mk. The booster rod loading required to provide 10 mk of reactivity is 780 g U^{235} per booster rod. (J.R.D.)

18686 (BAW-1224) FEASIBILITY OF MECHANICAL CONTROL FOR THE ADVANCED TEST REACTOR. S. W. Spetz and W. K. Luckow (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Sept. 1961. for Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 13p. (IDO-24038)

For a 17-day cycle, a 40-50-60 Mw interlobe power split and the specified experimental conditions can be maintained in the Advanced Test Reactor as controlled by the reference mechanical control system. The reactor performance was simulated by the two-dimensional "Turbo" lifetime code. All controls were operated during the lifetime. The control positions were selected without benefit of a prior systematic power distribution study. (auth)

18687 (IDO-16678) MTR FAST NEUTRON FLUX MEASUREMENTS FOR CYCLE 146. L. D. Weber and C. H. Hogg (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 20, 1962. Contract AT(10-1)-205. 49p.

The fast neutron fluxes in selected positions of the MTR were measured for Cycle 146. The measurements were made at the beginning, throughout, and at the end of the

cycle (564 Mwd). Vertical traverses for each position monitors are shown. (auth)

18688 (SGAE-61/5 B) ARBEITSBERICHT UND VERSUCHSERGEBNISSE DES ASTRA-REAKTORS, APRIL BIS JUNI 1961. (Work Report and Experimental Results for the ASTRA Reactor, April–June 1961). H. Bruneder, A. Burtscher, H. Kratschmann, A. Nedelik, and F. Woloch (Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Vienna). 68p.

Progress on the ASTRA reactor is reported. Critical experiments, reactivity measurements, construction of the graphite reflector, and void measurements for Core III are described. Investigations of the tightness of the reactor structure are discussed. Calculation of the zero energy transfer function of the ASTRA reactor is described. Results of calculations of activity release in a reactor accident are included. (M.C.G.)

18689 (TID-3571) FAST NEUTRON PULSE REACTORS AND FAST NEUTRON CRITICAL ASSEMBLIES. A Literature Search. William E. Bost, comp. (Division of Technical Information Extension, AEC). Apr. 1962. 20p.

A bibliography on fast neutron pulse reactors and fast neutron critical assemblies is presented. The 122 references are to reports, journal articles, and other published literature. (M.C.G.)

18690 DESIGN AND SAFETY FEATURES OF DAPHNE. H. R. McK. Hyder, E. S. F. King, and D. J. Merrett (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Eng., 7: No. 72, 178-83(May 1962).

Heavy water moderated and enriched uranium-fueled Daphne, a zero energy reactor, consists of an aluminum reactor vessel into which lattice plates, fuel, and thimbles can be loaded to mock-up either a Dido or a Pluto core arrangement. Provision is made to measure the effect on reactivity of rigs, loops, and samples destined for the high flux reactors. Daphne also provides a convenient test facility for new designs of control and safety mechanisms and fuel elements. Daphne can also be used for fundamental studies of reactor physics of high neutron leakage heavy water systems and for experiments on reactor kinetics. Improved methods of flux measurement and neutron spectrometry will also be tried out in Daphne. The power level will be restricted to a maximum of 100 w. A fast shut-down system consists of four independent safety rods acting inside four of the fuel elements. Schematic diagrams are presented of heavy water flow system, heavy water dump valve, reactor core set up for a Pluto test, fuel element, reactor top plate, and the reactor. Characteristics of nucleonic and physical instruments are given. The operational program is outlined. (N.W.R.)

18691 ZERLINA–CONTROL AND SAFETY SYSTEM. A. S. Rao, B. S. Prabhakar, and U. Venkateshwarlu (Atomic Energy Establishment, Trombay, India). Nuclear Eng., 7: No. 72, 198-202(May 1962).

The multiplicity of India's Zerlina reactor control and safety system is described. Zerlina is a natural uranium-heavy water research unit for measuring buckling, substitution, oscillation, and danger coefficient. The zero energy reactor for lattice investigations has a maximum operating power of 400 w. The complex control and safety system is schematically shown along with the flow system of the reactor. The safety system is complex due to the possibility of a transient occurring because of the wide and frequent variations in the fuel-moderator configurations. Special emphasis is on the various instruments and valves used. (N.W.R.)

18692 REDUNDANT SAFETY CHANNEL FOR ARGONAUT-TYPE REACTOR. Agustín Tanarro and Javier Goñi (Junta de Energía Nuclear, Madrid). Nucleonics, 20: No. 5, 86; 88-9(May 1962).

To increase safety and reliability of the low-power research reactor, several unique features were added to its safety channels. In addition to the usual startup channel, subcritical multiplication channel, and period channel, the reactor is supplied with three identical linear channels with seven measuring scales and a BF_3 chamber for each channel. Since these channels are not interconnected in any coincidence arrangement, any one independently can scram the reactor. This system offers many advantages of a 2-out-of-3 coincidence system without decreasing safety with respect to the 1-out-of-3 system. The circuitry is shown for the warning systems. (N.W.R.)

SPACE APPLICATIONS AND TECHNOLOGY

18693 (AD-265834) THE GLOW DISCHARGE AS AN ADVANCED PROPULSION DEVICE. S. I. Cheng (Aero-Chem Research Labs., Inc., Princeton, N. J.). Mar. 1961. Contract NOnr-2773(00). 22p.

The generation of thrust directly from electric power through a gaseous discharge is investigated with a one dimensional model. The thrust consists of 2 parts, the electric pressure and the electric wind. In terms of the ionization constants of gases and of the mobility constants of ions and electrons, both the electric pressure and the electric wind are obtained in simple dimensionless form. At low gas pressures, the thrust contribution from electric pressure is usually much larger than that from electric wind. The latter may be of comparable magnitudes or even much larger at higher (atmospheric) discharge pressures and larger inter-electrode distances. The over-all thrust level is proportional to the gas pressure in the discharge (P) squared. For p = 1 mm Hg, the thrust is less than or about equal to 1 dyne/sq cm. The specific thrust/unit power is no greater than 10 mg wt/kw. Thrust is derived from electric wind at a much larger specific power consumption. The low specific thrust rules out using such a propulsion system as a booster. For application in outer space, it suffers from the limited specific impulse because propellant gas must be carried aboard. The system has other interesting applications such as a positive control device for hypersonic vehicles at an altitude of 100–200 × 10,000 ft. (auth)

18694 (AD-265961) ADVANCED PROPULSION STUDIES. SUMMARY OF RESEARCH IN THE FIELD OF ADVANCED NUCLEAR PROPULSION. Semiannual Technical Report, January 1–June 30, 1961. M. L. Rosenzweig (Aerospace Corp., El Segundo, Calif.). Contract AF04(647)-594. 60p. (TDR-594(1203-01) STR)

A summary is presented of work performed in the field of advanced nuclear propulsion. The research study is concerned with gaseous nuclear propulsion systems, and particularly with the fluid dynamics problems associated with the development of a gaseous vortex reactor. A significant accomplishment was the generation of 25 stable vortices in a single container. This device, known as the vortex matrix, is designed to reduce viscous dissipation and turbulence levels below those values inherent in single, jet-driven vortex tubes. A second experiment, designed to evaluate turbulent shear distributions in single, jet-driven vortices, is also described and, in addition, associated analytical studies are discussed. An analytical study concerning magnetohydrodynamic vortex power generation was performed. (auth)

18695 (AFOSR-1399) ELECTROSTATIC SCREENING OF BODIES IN SPACE. Technical Report No. 226. S. F. Singer and E. H. Walker (Maryland. Univ., College Park). Sept. 1961. 16p. (AD-263806)

Bodies in space subject to the solar untraviolet flux will emit photoelectrons. A certain number of these escape and are balanced by the accretion of thermal electrons from the surrounding plasma. For a positively charged body, a much larger number of photoelectrons is released from the surface but do not escape because their energy is insufficient to do so. Their effect is to produce an inner screening of the body's electric charge. This screening is calculated for spherical bodies as a function of size. For large bodies the space charge density of photoelectrons becomes quite large; in the case of the Moon it reaches a value of the order of 1000 to 10,000 electrons per cc just above the lunar surface. For small dust particles, however, the photoelectric cloud becomes negligible. (auth)

18696 (MND-P-3017-I) SNAP RADIOISOTOPE SPACE PROGRAMS QUARTERLY PROGRESS REPORT NO. 9, OCTOBER 1 THROUGH DECEMBER 31, 1961. (Martin Co. Nuclear Div., Baltimore). Contract AT(30-3)-217. 17p.

All Phase I and Phase II testing was completed. Both launches of Phase I were successful, neither Phase II launches were successful. Test data recovered on Phase I launchings included optical coverage of re-entry and the trajectory and weather data; no telemetry canister temperature data were obtained. No test data were obtained on Phase II experiments. Reduction of Phase I test data was begun. The Phase II (Sub-subtask 7.3.2) was terminated December 20, 1961, when no test data were recovered for comparison with the analytically predicted results. The Sub-subtask 7.3.3 program (Generator Re-entry Burnup Study) was completed and terminated December 29, 1961. The study objectives were met. The Sub-subtask 7.3.4 program (High Altitude Sampling) was terminated when it was completed November 30, 1961. All study objectives were met. Topical reports were prepared on Sub-subtasks 7.3.1, 7.3.2, 7.3.3 and 7.3.4 in December 1961. Information on the work performed in the reporting period that was not included in the topical reports is included. Checkout and troubleshooting operations on the last two subroutines and main radioisotope shielding code were completed. Results from several runs of a simple check problem compared well with published data. (auth)

18697 (R62SD29) CYCLOTRON RESONANCE PROPULSION SYSTEM. David B. Miller, Per Gloersen, Edward F. Gibbons, and David J. BenDaniel (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Apr. 1962. Contract NAS 5-1046. 13p.

A description is given of a system in which plasma is generated and accelerated by a combination of a d-c magnetic field and a c-w, high-frequency electromagnetic field. Theoretical analysis of the processes by which energy is transferred from the electromagnetic field to the plasma is included. Some practical considerations concerning application of this system are also mentioned. The theoretical conclusion is reached that under proper conditions energy can be efficiently transferred to the plasma. A further conclusion is that the system operation is most favorable at power levels of 50 kw and more. (auth)

18698 (RADC-TR-61-219) THE UTILIZATION OF X-RADIATION AS A COMMUNICATIONS MEDIUM IN OUTER SPACE. Joris Brinkerhoff and Paul Frederickson (Tracerlab, Inc., Waltham, Mass.). June 23, 1961. Contract AF 30(602)-2189. 11p. (AD-264907)

Conditions for the optimum utilization of x radiation as a means of communication in outer space are considered. The broad areas of consideration include the question of proper selection of x ray energy in relation to the expected background radiation in outer space, means of x radiation generation, means for its detection, and the conditions for modulation and demodulation which would permit the most rapid and reliable transmission of information. (auth)

18699 (TID-15480) LOGIC MODULES FOR SPACE APPLICATIONS. F. E. Thompson (Sandia Corp., Albuquerque, N. Mex.). Mar. 20, 1962. Contract [AT (29-1)-789]. 19p.

A family of modules designed for use in the Vela Hotel Far Earth Satellite is described. Considerations which affected the design are discussed along with physical packaging. Circuit diagrams are included. (J.R.D.)

18700 ELECTRIC POWER FOR SPACE VEHICLES. Howard C. Zachmann (Martin Marietta Corp., [Baltimore]. Aerospace Eng., 21: 68-9; 78; 82-6(May 1962).

Numerous charts are presented showing values of the various parameters involved in space-vehicle electric-power systems. Characteristics are given of solar batteries, fuel cells, thermoelectric cells, thermionic cells, gas turbine engines, turbines, storage batteries, and reciprocating engines. Although primarily concerned with electric power components, generation and energy conversion are also discussed with respect to load and energy storage. (N.W.R.)

18701 NUCLEAR FUEL FOR SPACE TRAVEL. John Duncanson. Nuclear Energy, 165-74(Apr. 1962).

A review is given of nuclear power systems for space flight. Topics included are: fuel requirements, space loads, reactor selection, space flight, auxiliary power systems, and the American program. Auxiliary power systems discussed include: Transit IV-A, SNAP-8, SNAP-10A, and other direct conversion systems. The paper is to be used as the opening address at the International Conference and Symposium in Milan on "Man and Technology in the Nuclear and Space Age," April 12 to 27, 1962. (N.W.R.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 17921.

18702 (CEA-2102) ELIMINATION COMME DECHET RADIOACTIF D'UN FOUR DE FLUORATION EN PROVENANCE DE L'USINE D'EXTRACTION DU PLUTONIUM. (The Elimination as Radioactive Waste of a Fluorination Furnace from the Plutonium Extraction Plant). P. Boutot, A. Capitaine, and L. Giachetto (France. Commissariat à l'Énergie Atomique. Centre de Production de Plutonium de Marcoule, Chuscian). 1961. 18p.

The furnace, 1.60 × 0.75 × 0.80 m in dimensions, was placed inside a 2.50 × 1.25 × 2 m glove box. Operations performed included removal of the furnace from the glove box, storage of the furnace in a special container, and reduction to a minimum volume and elimination of the glove box. A very high α activity, oxidation of the various canalizations, and waste products trapped in the box necessitated special safety measures such as fixing of the contamination, crushing, and the use of appropriate vinyl envelopes. This long and tedious work was carried out with no resulting bodily or atmospheric contamination. (auth)

18703 (CRER-1077) MOVEMENT OF RADIOACTIVE WASTE THROUGH SOIL. 4. MIGRATION FROM A SINGLE SOURCE OF LIQUID WASTE DEPOSITED IN POROUS MEDIA. P. J. Parsons (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1962. 25p. (AECL-1485).

A soil survey was carried out in a wooded region surrounding a disused plant where waste liquid fission products were concentrated. During operations in 1954 acid waste containing complexing agents and more than 1000 nominal curies of mixed fission products was poured into a pit excavated in dry sand and lined with limestone. Radionuclides migrated in the groundwater away from the disposal pit and the pattern of this movement was investigated by intensive sampling with a multiple soil sampler. Ru^{106} migrated rapidly soon after the disposal. This was followed by slower moving Sr^{90} that developed into a continuous tongue 650 ft long, containing 800 curies. No other radionuclides were found in the tongue. It is estimated that Sr^{90} will escape into surface waters in about 130 years. However, the rate of release will not cause the concentration in a nearby drainage stream to rise above the maximum permissible concentration for occupational workers (ICRP). Figures and tables are included. (auth)

18704 (HW-72531) PHYSICAL PROPERTIES OF SIMULATED DECONTAMINANT WASTE SOLUTIONS. R. D. Weed (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 30, 1962. Contract AT(45-1)-1350. 14p.

The physical properties of simulated reactor decontaminant waste were determined. In addition, a determination was made of freezing points, pH, and settling rate of the precipitate for the solutions. (auth)

18705 (NP-11496) LIQUID RADIOACTIVE WASTE DISPOSAL FACILITY. Final Engineering Report. W. F. Swanton and M. L. Hyman (Pfaudler Co., Rochester, N. Y.). Mar. 1962. Contract DA18-108-405-CML-1030. 67p. (PF 62-5)

A liquid radioactive waste disposal facility was designed, developed, and installed at Nuclear Defense Laboratory for extensive tests and evaluation. The facility is being used for concentration of radioactive wastes from the Army nuclear power program and biological and medical research. It employs a Pfaulder Wiped Film Evaporator to effect gross decontamination of the waste and concentration of the waste by a factor of approximately 100. Condensate from the evaporator is further decontaminated by passage through Permutit mixed-bed demineralizers. The facility is a self-contained, transportable, semi-automatic assembly with components for feeding, monitoring, residue storage, pumping control, and includes ancillary equipment mounted on the same skid. Results of preliminary evaluation tests using feed spiked with Co^{60} to an activity $>8.7 \times 10^{-4}$ $\mu c/ml$ in β indicate an over-all DF of approximately 10^6 to 10^7. Initial test results did not determine ultimate facility capability because of errors in the vent piping, which were corrected, and analytical limits imposed by background activity. DF for α appears to be about 10^3. Additional testing continues and will be reported by the Chemical Corps. (auth)

18706 (ORNL-TM-210) A STUDY OF MODIFICATIONS FOR ORNL LIQUID WASTE SYSTEM. I. HIGH-LEVEL STORAGE TANKS AND INTERMEDIATE-LEVEL EVAPORATOR. H. O. Weeren, J. O. Blomeke, and W. G. Stockdale (Oak Ridge National Lab., Tenn.). Apr. 27, 1962. Contract [W-7405-Eng-26]. 52p.

As a means of reducing the quantity of radioactivity released to the environment by radioactive liquid waste discharges at ORNL, it is proposed that two 50,000-gal stainless steel storage tanks and a 600 gph stainless steel, submerged-coil evaporator be installed. The tanks, approximately 10 ft in diameter by 85 ft long, will be equipped with cooling coils attached to their outside surfaces for removal of a maximum of 300,000 Btu/hr of decay heat, and will be supported inside a concrete vault for containment. The evaporator and a feed tank will be installed inside a cell shielded with 5 ft of concrete and will process mainly intermediate-level waste from the concrete tank farm, but will be able to evaporate high-level waste as well, if required. Two additional cells for the condenser and other off-gas equipment will be housed with the evaporator cell in a building with an operating area and sampling gallery. The capital cost of this installation is estimated to be $1,226,000. (auth)

18707 (ORNL-TM-211) DESIGN CRITERIA FOR THE HIGH- AND INTERMEDIATE-LEVEL LIQUID WASTE FACILITY. F. E. Harrington and H. O. Weeren (Oak Ridge National Lab., Tenn.). Apr. 27, 1962. Contract [W-7405-Eng-26]. 53p.

Design criteria are given for the ORNL High- and Intermediate-Level Liquid Waste Facility. (J.R.D.)

18708 (Y-BG-15) RECOVERY OF URANIUM FROM UNIRRADIATED SCRAP AT Y-12. J. R. Barkman (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). May 1, 1962. Contract W-7405-Eng-26. 23p.

The recovery of unirradiated uranium scrap in the Y-12 plant is discussed. Processing to an accountability point is described. Material receiving, processing to a sampling point, shipper-receiver discrepancies, and alloy dissolution are topics covered. (M.C.G.)

18709 (JPRS-12637) RADIOACTIVE WASTES IN THE ATMOSPHERE. THE PLANNING OF FACILITIES FOR

REMOVING WASTES FROM AEROSOLS AND GASES. S. A. Prechistenskii (Prechistenskiy). Translated from p.1-14; 155-70 of "Radioaktivnye Vybrosy V Atmosferu. Proektirovanie Ustanovok Dlya Ochistki Vybrosov ot Aerozolei i Gazov" (a Publication of the State Publishing House for Literature in the Field of Atomic Science and Technology, Moscow, 1961). 67p.

General features of aerosols are reviewed, and the use of models in the design optimization of a facility for removal of radioactive dust and toxic gases from air is outlined. Methods are described for removal of these materials from air, utilizing filtration, absorption, adsorption, centrifuging, or combined methods. Precautions necessary for the prevention of the formation and spread of aerosols are discussed. Tabulations are given of maximum permissible concentrations of toxic gases, vapors, dusts, aerosols, and radioactive substances in the air in working areas, zones under sanitation protection, and populated areas. Parameters are tabulated for operation of a foam-bed facility for contaminant removal from air. (T.F.H.)

18710 A CONTRIBUTION TO THE STUDY OF RADIOACTIVE WASTE DILUTION IN THE RHONE INVOLVING TESTS WITH A RHODAMINE B TRACER. J. Rodier and M. Marichal (Commissariat à l'Énergie Atomique, France). Houille blanche, [16]: No. 5, 636-41(Oct. 1961). (In French)

The process whereby waste from the Marcoule plant mixes with the water in the Rhone was followed in tests with rhodamine as a chemical tracer. Satisfactory dispersion was noted less than 4 km downstream from the waste discharge duct outlet, and the degree of homogeneity was considered to be satisfactory at the bridge of Roquemaure, and perfect at Avignon. The investigation not only revealed a complete absence of any preferential flow paths containing high radioactive waste concentrations, but it also enabled the most representative points to be selected at which to take Rhone water samples during future radioactive waste discharges. (auth)

18711 THE HAZARDS OF ATOMIC WASTES. PERSPECTIVES AND PROPOSALS ON OCEANIC DISPOSAL. Alton Frye. Washington, D. C., Public Affairs Press, 1962. 51p. $1.00.

Problems associated with the disposal of radioactive wastes in oceans are reviewed. The practice of concentrating and then isolating low-level wastes by sea disposal is discussed. It is pointed out that it is assumed the containers would be effective for at least ten years, during which time atomic decay would greatly reduce the menace presented by the wastes. The United States Atomic Energy Commission has established a number of approved dumping locations in waters at least 6,000 feet deep. The containers have been 55-gal steel drums weighted with concrete. The results of the anticipated injection of low-level wastes into the upper layer of the ocean are considered from the standpoint of both health factors and economics. (C.H.)

18712 TREATMENT AND DISPOSAL OF RADIOACTIVE WASTES. C. B. Amphlett. International Series of Monographs on Nuclear Energy. Division V. Health Physics. Volume 2. New York, Pergamon Press, 1961. 296p. $12.00.

Developments in the field of waste treatment and disposal in atomic installations throughout the world are described along with the principles of these developments. After discussion of the origins and problems of wastes, the question of chemical separation is considered from the viewpoints of both waste treatment and recovery of potentially valuable materials. An account of the evaporation and storage of highly-active wastes is followed by a description of attempts being made to convert such wastes into stable solids for long-term storage. The disposal of solid wastes is outlined. The treatment of low activity wastes and gaseous wastes is also described. The possible future developments, including studies directed toward integrated schemes of waste disposal and the optimization of costs of treatment, are projected. (N.W.R.)

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æ	becomes	ae
ö		oe
ø		oe
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264907*	16-18698	See RADC-TR-61-219
265005*	16-18290	See AFCRL-1015
265076*	16-18149	See BRL-1137
265113*	16-18552	OTS
265129*	16-18016	OTS
265199*	16-18146	See ASD-TR-61-102
265213*	16-18084	See LMSD-703735-1
265431*	16-17919	See WADD-TR-60-827
265461*	16-18138	OTS
265526*	16-18317	OTS
265580*	16-18662	See OSB-6
265581*	16-18663	See OSB-13
265582*	16-18664	See OSB-15(Rev.1)
265583*	16-18665	See OSB-16
265584*	16-18666	See OSB-18
265620*	16-18021	See ARF-2182-B1-27
265625*	16-18044	See WADD-TR-60-889
265764*	16-18139	OTS
265834*	16-18693	OTS
265840*	16-17992	OTS
265961*	16-18694	OTS
266019*	16-18017	OTS
266038*	16-18556	See AFOSR-1546
266081*	16-18553	OTS
266087*	16-18140	OTS
266098*	16-18557	See PIBMRI-893-61
266196*	16-18554	
266220*	16-18141	OTS
266312*	16-17436	OTS
266359*	16-18144	See ARL-16
266519*	16-18292	See GCA-TR-60-4-G
266553*	16-18142	OTS
266561*	16-18318	See AFOSR-1568
266647*	16-18469	See AFOSR-1566
266937*	16-18018	
267039*	16-18147	See ASD-TR-61-125
268772*	16-18555	See AFCRL-735
AEC-tr–		
4144	16-17343	Dep.; $0.50(OTS)
4145	16-17344	Dep.; $0.50(OTS)
4146	16-17345	Dep.; $0.50(OTS)
4147	16-17346	Dep.; $0.50(OTS)
4150	16-17347	Dep.; $0.75(OTS)
4151	16-17348	Dep.; $0.50(OTS)
4456	16-17619	Dep.; $3.75(OTS)
4459	16-17630	Dep.; $3.75(OTS)
4941	16-17753	Dep.; $0.50(OTS)
5014	16-17764	Dep.(mc); $2.60(fs), $0.89(mf) JCL
5025	16-17349	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
5026	16-17350	Dep.(mc); $5.60(fs), $1.76(mf) JCL or OTS
5027	16-17640	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
5029	16-17351	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
5030	16-17352	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
5066	16-18125	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
5086	16-18045	Dep.(mc); $1.10(fs), $0.80(mf) JCL
5087	16-17641	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5088	16-17642	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5101	16-17884	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
5102	16-17827	$1.60(fs), $0.80(mf) JCL
5104	16-18046	Dep.(mc); $1.10(fs), $0.80(mf) JCL
AECL–	**(Canadian)**	
1455	16-18617	See EXP-NRX-70103
1482	16-17464	Can. J. Biochem. and Physiol. 40: 619-30 (1962)
1485	16-18703	See CRER-1077
AEDC-TDR–	**(Non-AEC)**	
62-19	16-18019	
AERE-Bib–	**(British)**	
122(Suppl.I)	16-17908	Dep.; $0.63(BIS)
AERE-CE–	**(British)**	
R-1828	16-17777	Dep.; $0.35(BIS)
AERE-M–	**(British)**	
911	16-18608	Dep.; $0.25(BIS)
985	16-17909	$0.25(BIS)
1020	16-18609	Dep.; $0.49(BIS)
AERE-R–	**(British)**	
3748	16-18092	J. Nuclear Energy, Pt. C., Plasma Phys.-Accelerators-Thermonuclear Research 4: 89-93(1962)
3942	16-17610	Dep.; $0.25(BIS)
3951	16-17586	Dep.; $0.35(BIS)
M-132	16-18608	For declassified version see AERE-M-911
AERE-Trans–	**(British)**	
882	16-17948	Dep.
887	16-18047	
AF-SAM–	**(Non-AEC)**	
62-7	16-17531	
AFCRL–	**(Non-AEC)**	
54	16-18161	See ML-779
735	16-18555	OTS
1015	16-18290	OTS
62-287	16-18289	
AFOSR–	**(Misc.)**	
1399*	16-18695	OTS
1440*	16-18143	OTS
1499	16-18508	Phys. Rev. 126: 663-70(1962)
1519*	16-17611	
1545*	16-18291	
1546*	16-18556	OTS
1566*	16-18469	OTS
1568*	16-18318	OTS
1591*	16-17792	
2066	16-18360	Phys. Rev. 124: 670-97(1961)
2117*	16-18319	
2230*	16-18020	
AFSWC-TDR–	**(Non-AEC)**	
61-100(Vols.I&II)	16-18645	
62-26	16-18284	OTS
AI–	**(Misc.)**	
3739*	16-17910	Dep.(mc); $8.60(fs), $2.99(mf) OTS
ANL–		
6536	16-17814	Dep.; $0.50(OTS)
6544	16-18610	Dep.; $1.50(OTS)

Report No.	Abstract No.	Availability
AP-Note–	**(Non-AEC)**	
362	16-18664	See OSB-15(Rev.1)
APAE–	**(Misc.)**	
95	16-18646	Dep.(mc); $12.00(fs), $5.09(mf) OTS
103	16-18647	Dep.(mc); $14.00(fs), $6.41(mf) OTS
111	16-18648	Dep.(mc); $7.60(fs), $2.42(mf) OTS
APAE-Memo–	**(Misc.)**	
283	16-18649	Dep.(mc); $7.60(fs), $2.42(mf) OTS
314	16-18650	Dep.(mc); $6.60(fs), $2.12(mf) OTS
ARAP–	**(Non-AEC)**	
1-R	16-18140	See AD-266087
ARF–	**(Misc.)**	
2182-B1-27*	16-18021	OTS
2212-4*	16-17993	OTS
ARL–	**(Non-AEC)**	
16	16-18144	OTS
ASD-TR–	**(Non-AEC)**	
61-11(Vol.II)	16-18145	
61-102	16-18146	OTS
61-125	16-18147	OTS
61-704	16-18148	
BAW–	**(Misc.)**	
1224	16-18686	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1241	16-18651	Dep.; $4.50(OTS)
BLG–	**(Belgian)**	
75	16-17545	Rev. franc. etudes clin. et biol. 6: 378-93 (1961)
BM-IC–	**(Non-AEC)**	
8048	16-18022	$0.50(GPO)
BM-RI–	**(Misc.)**	
5969	16-17911	Dep.(mc); $2.60(fs), $0.92(mf) OTS
BMI–	**(Misc.)**	
1541(Del.)	16-17966	Dep.; $2.00(OTS)
BNL–		
713	16-18611	Dep.; $2.25(OTS)
721	16-17815	Dep.; $0.50(OTS)
4988	16-18445	p. 351-60 of "Pile Neutron Research in Physics" Vienna, International Atomic Energy Agency, 1962
5240	16-17384	p. 103-10 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962
5333	16-17389	p. 149-53 of "Tritium in the Physical and Biological Sciences. Vol. II." Vienna, International Atomic Energy Agency, 1962
5338	16-17447	Am. J. Botany 48: 691-9(1961)
5573	16-18630	Nuclear Sci. and Eng. 12: 482-9(1962)
5580	16-17506	Radiation Research 16: 189-200(1962)
5647	16-18413	Nuclear Sci. and Eng. 12: 532-41(1962)
5655	16-17720	J. Phys. Chem. 66: 926-30(1962)
5687	16-17536	Blood 19: 738-42(1962)
5688	16-17535	Blood 19: 724-37(1962)
5716	16-18506	Phys. Rev. 126: 648-52(1962)
5728	16-17946	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5802	16-18067	Phys. Rev. 126: 556-65(1962)
5813	16-18370	Phys. Rev. 126: 747-56(1962)
5829	16-18515	Phys. Rev. 126: 729-34(1962)
BRL–	**(Misc.)**	
1137*	16-18149	OTS
CEA–	**(French)**	
1708	16-17839	Bull. soc. franc. mineral. et crist. 84: 13-19(1961)
2042	16-18190	Compt. rend. 253: 433-5(1961)
2063	16-18189	Compt. rend. 253: 215-17(1961)
2102	16-18702	Dep.(mc)
CEA-tr–	**(French)**	
R-1569	16-17592	Dep.(mc); $1.60(fs), $0.80(mf) JCL
CERN–	**(European Organization for Nuclear Research)**	
62-13	16-18594	Dep.(mc)
CHI–	**(Italian)**	
103	16-18243	Phys. Rev. 123: 141-7(1961)
CNLM–		
1758	16-17994	Dep.(mc); $1.10(fs), $0.80(mf) OTS
CRER–	**(Canadian)**	
1077	16-18703	Dep.; $1.00(AECL)
CYNA–	**(Misc.)**	
113	16-17975	Dep.(mc); $8.60(fs), $3.02(mf) OTS
127	16-18023	Dep.(mc); $4.60(fs), $1.43(mf) OTS
D–	**(Misc.)**	
1-82-0149*	16-17612	
DC–	**(Misc.)**	
58-9-84	16-18126	Dep.(mc); $5.60(fs), $2.00(mf) JCL or OTS
59-7-700	16-18612	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DLCS–		
3410101	16-18671	See TID-14885
3500261	16-18670	See TID-14884
DMIC–	**(Non-AEC)**	
167	16-18024	OTS
DP–		
647	16-17759	Dep.; $0.50(OTS)
691	16-17995	Dep.; $0.50(OTS)
702	16-17760	Dep.; $0.50(OTS)
706	16-18652	Dep.; $0.50(OTS)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EU-B–	**(German)**	
4	16-18150	See EURAEC-65
EURAEC–		
4	16-17996	$2.60(fs), $0.95(mf) OTS
6	16-18025	Dep.(mc); $1.10(fs), $0.80(mf) OTS
13	16-17997	Dep.(mc); $2.60(fs), $0.86(mf) OTS
22	16-18613	Dep.(mc); $8.10(fs), $2.69(mf) OTS
34	16-17793	Dep.(mc); $1.60(fs), $0.80(mf) OTS
49	16-17794	Dep.(mc); $8.10(fs), $2.84(mf) OTS
54	16-17795	$6.60(fs), $2.12(mf) OTS
65	16-18150	Dep.(mc); $1.60(fs), $0.80(mf) OTS
67	16-18038	See NYO-9046
78	16-18026	Dep.(mc); $3.60(fs), $1.25(mf) OTS
94	16-17976	Dep.(mc); $9.60(fs), $3.62(mf) OTS
96	16-18614	Dep.(mc); $2.60(fs), $1.10(mf) OTS
99	16-17778	Dep.(mc); $4.60(fs), $1.70(mf) OTS
100	16-18618	See NDA-2132-2
105	16-17796	Dep.(mc); $4.60(fs), $1.49(mf) OTS
107	16-17816	Dep.(mc); $2.60(fs), $1.01(mf) OTS
108	16-17797	Dep.(mc); $6.60(fs), $2.18(mf) OTS
112	16-17998	Dep.(mc); $4.60(fs), $1.46(mf) OTS
113	16-17999	Dep.(mc); $1.60(fs), $0.80(mf) OTS
119	16-18000	Dep.(mc); $2.60(fs), $1.01(mf) OTS
122	16-17968	Dep.(mc); $3.60(fs), $1.37(mf) OTS
123	16-18080	Dep.(mc); $1.60(fs), $0.80(mf) OTS
124	16-18001	Dep.(mc); $1.10(fs), $0.80(mf) OTS
141	16-17977	$9.60(fs), $3.62(mf) OTS
145	16-17798	Dep.(mc); $7.60(fs), $2.36(mf) OTS
158	16-18615	Dep.(mc); $1.10(fs), $0.80(mf) OTS
175	16-17978	Dep.(mc); $6.60(fs), $2.27(mf) OTS
180	16-18081	Dep.(mc); $5.60(fs), $1.79(mf) OTS
186	16-18027	Dep.(mc); $2.60(fs), $0.86(mf) OTS
191	16-18616	Dep.(mc); $3.60(fs), $1.25(mf) OTS
193	16-18002	Dep.(mc); $1.60(fs), $0.80(mf) OTS
197	16-18028	Dep.(mc); $2.60(fs), $0.86(mf) OTS
198	16-18003	Dep.(mc); $1.60(fs), $0.80(mf) OTS
209	16-17799	$9.10(fs), $3.47(mf) OTS
219	16-18004	Dep.(mc); $1.10(fs), $0.80(mf) OTS
225	16-18029	Dep.(mc); $1.10(fs), $0.80(mf) OTS
EXP–	**(Non-AEC)**	
278	16-17611	See AFOSR-1519
EXP-NRX–	**(Canadian)**	
70103	16-18617	Dep.; $1.00(AECL)
FN-E–	**(Italian)**	
4	16-17797	See EURAEC-108
11	16-18080	See EURAEC-123
12	16-18616	See EURAEC-191

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13	16-18002	See EURAEC-193
14	16-18028	See EURAEC-197
15	16-18003	See EURAEC-198
FTD-TT-	**(Non-AEC)**	
61-102	16-17828	OTS
61-310	16-18132	OTS
61-340	16-18673	OTS
61-345	16-18559	OTS
62-120	16-18133	OTS
62-144	16-17532	OTS
62-227	16-18134	OTS
62-297	16-17643	OTS
62-338	16-18560	OTS
62-362	16-17437	OTS
FXM-	**(Misc.)**	
402	16-18653	Dep.(mc); $1.10(fs), $0.80(mf) OTS
412	16-18082	Dep.(mc); $1.10(fs), $0.80(mf) OTS
420	16-17912	Dep.(mc); $1.10(fs), $0.80(mf) OTS
429	16-18654	$4.60(fs), $1.64(mf) OTS
479	16-18655	Dep.(mc); $1.10(fs), $0.80(mf) OTS
669	16-17780	See TIM-5
743	16-18030	$1.10(fs), $0.80(mf) OTS
FZK-	**(Non-AEC)**	
9-164	16-18163	See NARF-61-8T
FZM-	**(Non-AEC)**	
2025	16-17913	
GA-	**(Misc.)**	
2648	16-18083	Dep.; $2.00(OTS)
2671	16-18579	Phys. Fluids 5: 503-9(1962)
2734	16-18410	Nuclear Sci. and Eng. 12: 457-63(1962)
GAMD-	**(Misc.)**	
1172	16-18031	Dep.(mc); $2.60(fs), $0.89(mf) OTS
1895	16-18656	Dep.(mc); $3.60(fs), $1.13(mf) OTS
GCA-TR-	**(Non-AEC)**	
60-4-G	16-18292	OTS
GCM-UK-	**(British)**	
23	16-17613	Dep.(mc)
25	16-17705	Dep.(mc)
26	16-17979	Dep.(mc)
27	16-18032	Dep.(mc)
40	16-17614	Dep.(mc)
42	16-17706	Dep.(mc)
GEAP-	**(Misc.)**	
3562*	16-17800	
GEMP-		
10A	16-18033	Dep.; $0.75(OTS)
HPR-	**(Norwegian)**	
18	16-18657	Dep.(mc)
HW-		
69879(Rev.)	16-17817	Dep.; $0.75(OTS)
70649	16-17818	$2.60(fs), $0.92(mf) OTS
71214	16-18658	Dep.(mc); $3.60(fs), $1.25(mf) OTS
71352	16-17819	Dep.(mc); $1.60(fs), $0.80(mf) OTS
71666	16-18315	Dep.; $2.00(OTS)
71674	16-18683	Dep.(mc); $1.60(fs), $0.80(mf) OTS
72511	16-17409	Dep.; $0.50(OTS)
72531	16-18704	Dep.(mc); $1.60(fs), $0.80(mf) OTS
72586	16-18151	Dep.; $2.00(OTS)
73255	16-18592	$2.60(fs), $0.98(mf) OTS
73398	16-18034	Dep.; $0.50(OTS)
HW-SA-		
2197	16-17927	Health Phys. 8: 67-71(1962)
2282	16-18414	Nuclear Sci. and Eng. 12: 542-4(1962)
2356	16-17710	Anal. Chem. 34: 830-5(1962)
2530	16-17587	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2531	16-18035	Dep.(mc); $6.60(fs), $2.18(mf) OTS
2536	16-18160	Dep.(mc); $2.60(fs), $1.07(mf) OTS
2544	16-17360	Dep.(mc); $3.60(fs), $1.22(mf) OTS
HW-tr-		
34	16-18135	$4.60(fs), $1.61(mf) JCL or OTS
IA-	**(Non-AEC)**	
707	16-17410	Dep.(mc)
725	16-18470	Dep.(mc)
IDO-		
14579	16-17761	Dep.; $0.50(OTS)
16678	16-18687	Dep.; $1.25(OTS)
24038	16-18686	See BAW-1224
IFA-FT-	**(Rumanian)**	
39	16-18471	Dep.(mc)
41	16-18472	
INSJ-	**(Japanese)**	
48	16-18320	Dep.(mc)
IS-		
300	16-17615	Dep.; $1.75(OTS)
368	16-17600	Anal. Chem. 34: 796-800(1962)
JINR-	**(Russian)**	
D-821	16-17959	Dep.(mc)
JPRS-	**(Non-AEC)**	
12637	16-18709	OTS
12921	16-17438	OTS
13022	16-17533	OTS
13043	16-18323	OTS
13127	16-17949	OTS
13233	16-17829	OTS
13288	16-17442	OTS
13342	16-17443	OTS
13415	16-17534	OTS
KAPL-		
2067-2	16-17820	Dep.; $1.75(OTS)
KAPL-M-		
AA-1	16-17980	Dep.(mc); $2.60(fs), $0.92(mf) OTS
LAB-STU-	**(Italian)**	
1416	16-17794	See EURAEC-49
1451	16-17778	See EURAEC-99
1469	16-17799	See EURAEC-209
LMSD-	**(Non-AEC)**	
703735-1	16-18084	OTS
MATT-		
101	16-18581	Phys. Fluids 5: 517-24(1962)
107	16-18583	Phys. Fluids 5: 633-4(1962)
109	16-18580	Phys. Fluids 5: 510-17(1962)
MITS-		
47	16-17881	Dep.; $1.25(OTS)
ML-	**(Misc.)**	
779*	16-18161	OTS
MND-M-	**(Misc.)**	
1822	16-18659	Dep.(mc); $5.60(fs), $1.85(mf) OTS
MND-P-		
3017-1	16-18696	Dep.; $0.50(OTS)
MRL-	**(Non-AEC)**	
103	16-18162	OTS
NAA-SR-		
4534	16-18660	Dep.; $1.50(OTS)
6669	16-17707	Dep.; $3.60(fs), $1.19(mf) OTS
7098	16-18085	Dep.; $0.75(OTS)
7137	16-17960	Dep.; $2.00(OTS)
NARF-	**(Non-AEC)**	
61-8T	16-18163	OTS
NDA-	**(Misc.)**	
2132-2	16-18618	Dep.(mc); $7.60(fs), $2.36(mf) OTS
NP-	**(AEC File No. for Non-AEC Reports)**	
10458 Part A and Part B(Vols.1 thru 6)	16-17915	See NP-11526
11439	16-17338	Dep.(mc)
11457	16-18036	Dep.(mc)
11463(Pts.1,2 and 3)	16-18164	Dep.(mc)
11474	16-17947	Dep.
11490	16-18619	Dep.(mc)
11496	16-18705	
11502	16-18037	

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11503	16-18086	
11504	16-17339	Dep.; $2.10(BIS)
11505	16-17914	Dep.(mc)
11506	16-17340	
11510	16-17616	
11526	16-17915	Dep.(mc); $10.10(fs), $4.04(mf) OTS
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
871	16-17355	
NRL–	**(Misc.)**	
5646*	16-17821	
5764*	16-17916	
NYO–		
9046	16-18038	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9201	16-17881	See MITS-47
9537	16-18337	Nuovo cimento (10), 23: 556-63(1962)
9934(Vol.III)(p.75-81)	16-17608	Spectrochim. Acta 9: 40-6(1957)
10029	16-18298	J. Geophys. Research 67: 1289-93(1962)
10031	16-17961	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10129	16-18595	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10130	16-18321	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORNL–		
2943	16-17981	Dep.; $1.50(OTS)
2962	16-17982	Dep.; $1.25(OTS)
3155	16-17762	Dep.; $0.75(OTS)
3261	16-18661	Dep.; $1.75(OTS)
3262	16-17553	Dep.; $3.00(OTS)
ORNL-TM–		
122	16-17617	Dep.(mc); $5.60(fs), $1.85(mf) OTS
193	16-17763	Dep.(mc); $1.10(fs), $0.80(mf) OTS
210	16-18706	Dep.(mc); $5.60(fs), $1.76(mf) OTS
211	16-18707	Dep.(mc); $5.60(fs), $1.79(mf) OTS
OSB–	**(Non-AEC)**	
6	16-18662	OTS
13	16-18663	OTS
15(Rev.1)	16-18664	OTS
16	16-18665	OTS
18	16-18666	OTS
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,015,278	16-17788	
3,015,555	16-17772	
3,015,556	16-17773	
3,015,557	16-17774	
3,015,559	16-18079	
3,015,615	16-18635	
3,015,616	16-18636	
3,015,617	16-18637	
3,015,729	16-17855	
3,015,745	16-18280	
3,016,461	16-18281	
3,016,462	16-18638	
3,016,463	16-18639	
3,016,765	16-18640	
3,017,241	16-17756	
3,017,510	16-17856	
3,017,514	16-17955	
3,018,161	16-17700	
3,018,235	16-17747	
3,018,237	16-17748	
3,018,374	16-17609	
3,019,088	16-17957	
3,019,139	16-17749	
3,019,176	16-18680	
3,019,336	16-17857	
3,019,337	16-17858	
3,019,338	16-17859	
3,019,339	16-17860	
3,019,340	16-18282	
3,019,341	16-17861	
3,021,271	16-17991	
3,021,273	16-18681	
3,021,274	16-17862	
3,021,286	16-17863	
3,021,427	16-17864	
3,021,475	16-17865	
3,021,485	16-17866	
3,022,135	16-17757	
3,022,201	16-18007	
3,022,237	16-17750	
3,022,238	16-17867	
3,022,239	16-18641	
3,022,424	16-17868	
3,024,087	16-17775	
3,024,175	16-18008	
3,024,176	16-18009	
3,024,177	16-18010	
3,024,199	16-17701	
3,024,379	16-18549	
3,024,410	16-17869	
3,025,137	16-18011	
3,025,156	16-17789	
3,025,224	16-17958	
3,025,226	16-18642	
3,025,228	16-18643	
3,025,399	16-17879	
3,025,400	16-17870	
3,025,402	16-18283	
3,025,403	16-17945	
3,025,404	16-17871	
3,033,646	16-17776	
3,033,652	16-17751	
3,033,654	16-17905	
3,033,794	16-17702	
3,033,795	16-17703	
3,033,974	16-18012	
3,033,985	16-17872	
3,033,986	16-17873	
3,034,008	16-17874	
3,034,039	16-17875	
3,034,040	16-17876	
3,034,837	16-17790	
3,034,846	16-18550	
3,034,855	16-17758	
3,034,856	16-17704	
3,034,924	16-18013	
3,034,974	16-17752	
3,034,975	16-18644	
3,034,976	16-18682	
3,035,172	16-17877	
3,035,173	16-17878	
3,035,174	16-17906	
3,035,206	16-17791	
PATENTS	**(U.S.S.R.)**	
128,950	16-18134	See FTD-TT-62-227
PB–	**(Non-AEC)**	
151088	16-18024	See DMIC-167
PF–	**(Non-AEC)**	
62-5	16-18705	See NP-11496
PG-Report–	**(British)**	
284	16-17588	Dep.; $0.56(BIS)
292	16-17589	Dep.; $0.42(BIS)
318	16-17590	Dep.; $0.16(BIS)
PIBMRI–	**(Non-AEC)**	
893-61	16-18557	OTS
PNE–		
104P	16-17341	Dep.; $0.50(OTS)
128P	16-17342	Dep.; $0.50(OTS)
PPAD–		
450-E	16-17822	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PRDC-TR–		
54	16-18667	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PST-Cat.–	**(Misc.)**	

Report No.	Abstract No.	Availability
378	16-17619	See AEC-tr-4456
381	16-17630	See AEC-tr-4459
PUC–		
1962-64	16-18287	Nature 194: 329-30(1962)
R–	(Misc.)	
62SD29*	16-18697	
RADC-TN–	(Non-AEC)	
61-159	16-18161	See ML-779
61-199	16-18121	
61-201	16-18557	See PIBMRI-893-61
RADC-TR–	(Non-AEC)	
59-77	16-18668	
61-219	16-18698	OTS
RME–		
4516	16-17882	$0.50(OTS)
4523	16-17883	Dep.; $0.50(OTS)
SC–	(Misc.)	
4678(RR)	16-17917	Dep.; $0.50(OTS)
SCDC–		
2580	16-18041	See TID-15482
SCDR–		
54-62	16-17823	Dep.(mc); $2.60(fs), $0.95(mf) OTS
SCL-T–		
417	16-17781	Dep.(mc); $1.10(fs), $0.80(mf) JCL
SCTM–		
311-62-81	16-17824	Dep.; $0.50(OTS)
SGAE–	(Austrian)	
61/5 B	16-18688	Dep.(mc)
SI-publ.–	(Norwegian)	
324	16-18014	See AD-263880
325	16-18015	See AD-263881
SL–	(Misc.)	
1868(Suppl.1)	16-18620	Dep.; $2.00(OTS)
1915-3	16-18669	Dep.(mc); $1.60(fs), $0.80(mf) OTS
STI-PUB–	(International Atomic Energy Agency)	
36	16-18421	$12.00(IAEA)
39(Vol.II)	16-17375	$8.00(IAEA)
15/21	16-17956	$1.00(IAEA)
15/22	16-17974	$1.00(IAEA)
TDR–	(Non-AEC)	
594(1203-01)STR	16-18694	See AD-265961
TEI–		
810	16-17918	Dep.(mc); $11.00(fs), $4.46(mf) OTS
TID–		
3571	16-18689	Dep.; $0.50(OTS)
3907(Rev.I)	16-17825	Dep.; $1.00(OTS)
14258	16-18541	Dep.(mc); $2.60(fs), $0.83(mf) OTS
14387	16-17361	Dep.(mc); $7.60(fs), $2.45(mf) OTS
14769	16-18039	Dep.(mc); $6.60(fs), $2.21(mf) OTS
14812	16-17708	Dep.(mc); $16.00(fs), $7.52(mf) OTS
14884	16-18670	Dep.(mc); $8.10(fs), $2.69(mf) OTS
14885	16-18671	Dep.(mc); $3.60(fs), $1.25(mf) OTS
15209	16-18040	Dep.(mc); $10.50(fs), $4.13(mf) OTS
15480	16-18699	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15482	16-18041	Dep.(mc); $7.60(fs), $2.33(mf) OTS
15483	16-17779	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15485	16-17962	Dep.(mc); $5.60(fs), $1.94(mf) OTS
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TIM–	(Misc.)	
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384	16-17801	Dep.(mc); $1.60(fs), $0.80(mf) OTS
552	16-17802	Dep.(mc); $2.60(fs), $0.98(mf) OTS
TP–	(British)	
168A	16-17611	See AFOSR-1519
UCRL–		
6076(Suppl.1)	16-18621	Dep.(mc); $2.60(fs), $0.89(mf) OTS
6366	16-18502	Phys. Rev. 126: 295-302(1962)
6464	16-18510	Phys. Rev. 126: 693-7(1962)
6616	16-18420	Phys. Rev. 126: 632-42(1962)
6619	16-18258	Phys. Rev. 126: 163-8(1962)
6663	16-18262	Phys. Rev. 126: 370-2(1962)
6674-T	16-18263	Phys. Rev. 126: 373-5(1962)
6729	16-18622	Dep.; $0.50(OTS)
6769	16-18122	Dep.; $0.50(OTS)
6785	16-17618	Dep.; $0.50(OTS)
9734	16-18365	Phys. Rev. 126: 345-52(1962)
9830	16-18209	J. Opt. Soc. Am. 52: 504-7(1962)
9837	16-18362	Phys. Rev. 126: 303-9(1962)
9860	16-18257	Phys. Rev. 126: 147-62(1962)
9869	16-18495	Phys. Rev. 126: 252-7(1962)
9870(Rev.)	16-18500	Phys. Rev. 126: 274-6(1962)
9941	16-18371	Phys. Rev. 126: 763-5(1962)
9951	16-18322	Dep.; $1.50(OTS)
9954	16-18123	Dep.; $2.25(OTS)
9965	16-18296	J. Geophys. Research 67: 1255-62(1962)
9988	16-18558	Dep.; $0.50(OTS)
10113	16-18124	Dep.; $1.50(OTS)
UCRL-Trans–		
748	16-18564	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
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555	16-17411	
WADD-TR–	(Non-AEC)	
60-266	16-18043	
60-827	16-17919	OTS
60-889	16-18044	OTS
WAPD-T–		
1375	16-18631	Nuclear Sci. and Eng. 12: 490-7(1962)
Y–		
1142(Del.)	16-17591	Dep.(mc); $4.60(fs), $1.43(mf) OTS
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